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Meditation Practices for Health: State of the Research

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Preface

The Agency for Healthcare Research and Quality (AHRQ), through its Evidence-based Practice Centers (EPCs), sponsors the development of evidence reports and technology assessments to assist public- and private- sector organizations in their efforts to improve the quality of healthcare in the United States. This report was requested and funded by the National Center for Complementary and Alternative Medicine (NCCAM). The reports and assessments provide organizations with comprehensive, science-based information on common, costly medical conditions and new healthcare technologies. The EPCs systematically review the relevant scientific literature on topics assigned to them by AHRQ and conduct additional analyses when appropriate prior to developing their reports and assessments.

To bring the broadest range of experts into the development of evidence reports and health technology assessments, AHRQ encourages the EPCs to form partnerships and enter into collaborations with other medical and research organizations. The EPCs work with these partner organizations to ensure that the evidence reports and technology assessment they produce will become building blocks for healthcare quality improvement projects throughout the Nation. The reports undergo peer review prior to their release.

AHRQ expects that the EPC evidence reports and technology assessments will inform individual health plans, providers, and purchasers as well as the healthcare system as a whole by providing important information to help improve healthcare quality.

We welcome comments on this evidence report. They may be sent by mail to the Task Order Officer named below at: Agency for Healthcare Research and Quality, 540 Gaither Road, Rockville, MD 20850, or by email to epc@ahrq.gov.

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Structured Abstract

Objective: To review and synthesize the state of research on a variety of meditation practices, including: the specific meditation practices examined; the research designs employed and the conditions and outcomes examined; the efficacy and effectiveness of different meditation practices for the three most studied conditions; the role of effect modifiers on outcomes; and the effects of meditation on physiological and neuropsychological outcomes.

Data Sources: Comprehensive searches were conducted in 17 electronic databases of medical and psychological literature up to September 2005. Other sources of potentially relevant studies included hand searches, reference tracking, contact with experts, and gray literature searches.

Review Methods: A Delphi method was used to develop a set of parameters to describe meditation practices. Included studies were comparative, on any meditation practice, had more than 10 adult participants, provided quantitative data on health-related outcomes, and published in English. Two independent reviewers assessed study relevance, extracted the data and assessed the methodological quality of the studies.

Results: Five broad categories of meditation practices were identified (Mantra meditation, Mindfulness meditation, Yoga, Tai Chi, and Qi Gong). Characterization of the universal or supplemental components of meditation practices was precluded by the theoretical and terminological heterogeneity among practices. Evidence on the state of research in meditation practices was provided in 813 predominantly poor-quality studies. The three most studied conditions were hypertension, other cardiovascular diseases, and substance abuse. Sixty-five intervention studies examined the therapeutic effect of meditation practices for these conditions. Meta-analyses based on low-quality studies and small numbers of hypertensive participants showed that TM®, Qi Gong and Zen Buddhist meditation significantly reduced blood pressure. Yoga helped reduce stress. Yoga was no better than Mindfulness-based Stress Reduction at reducing anxiety in patients with cardiovascular diseases. No results from substance abuse studies could be combined. The role of effect modifiers in meditation practices has been neglected in the scientific literature. The physiological and neuropsychological effects of meditation practices have been evaluated in 312 poor-quality studies. Meta-analyses of results from 55 studies indicated that some meditation practices produced significant changes in healthy participants.

Conclusion: Many uncertainties surround the practice of meditation. Scientific research on meditation practices does not appear to have a common theoretical perspective and is characterized by poor methodological quality. Firm conclusions on the effects of meditation practices in healthcare cannot be drawn based on the available evidence. Future research on meditation practices must be more rigorous in the design and execution of studies and in the analysis and reporting of results.

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Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/downloads/pub/evidence/pdf/meditation/medit.pdf

Executive Summary

Introduction

The University of Alberta Evidence-based Practice Center (UAEPC) reviewed and synthesized the published literature on the state of the research of meditation practices for health. The research questions were organized under five general topics:

1. The practice of meditation;
2. The state of research on the therapeutic use of meditation practices in healthcare;
3. The evidence on the efficacy and effectiveness of meditation practices;
4. The evidence on the role of effect modifiers for the practice of meditation; and
5. The evidence on the physiological and neuropsychological effects of meditation practices.

Meditation has been a spiritual and healing practice in some parts of the world for more than 5,000 years. During the last 40 years, the practice of meditation has become increasingly popular in Western countries as a complementary mind-body therapeutic strategy for a variety of health-related problems. Meditation and its therapeutic effects have been characterized in many ways in the scientific literature. The complex nature of meditation and the coexistence of many perspectives adopted to describe the characteristics of the practice have contributed to great variations in the reports of its therapeutic effects across the studies. There is a need to evaluate the evidence that has emerged within the past several decades on the effects of meditation practices in healthcare.

Methodology

The UAEPC established a prospectively designed protocol for this evidence report. A Technical Expert Panel (TEP) was invited to provide high-level content and methodological expertise in the development of the report. Due to the lack of general consensus on a definition of meditation in the scientific literature, a set of parameters to describe meditation practices was evaluated by the TEP members using a modified Delphi methodology.

Literature Sources

Comprehensive searches were conducted in 17 relevant electronic databases up to September 2005. Other sources of potentially relevant studies included hand searches, reference tracking, contact with experts, and gray literature searches.

Study Selection

A set of strict eligibility criteria was used to include potentially relevant studies. They had to be comparative, be on any meditation practice, have more than 10 adult participants, provide quantitative data on health-related outcomes, and be published in English. The criteria of study methodology were modified to address each of the research topics of the review. Sources of secondary data (e.g., systematic reviews, narrative reviews, and book chapters) were used for topic I. Topics II to V included studies with a comparison/control group or control period: randomized controlled clinical trials (RCTs), nonrandomized controlled clinical trials (NRCTs) (topics III to V), prospective and retrospective observational studies with controls (topic II), case-control studies (topic II), uncontrolled before-and-after studies (topics II and V), and cross-sectional studies with controls (topic II).

Data extraction and Assessment of Study Quality

Trained research assistants extracted the data using a comprehensive and pretested data extraction form. One reviewer verified the accuracy and completeness of the data.

Studies included in the descriptive overview on the practice of meditation (topic I) were not assessed for methodological quality. For topics II to V, the methodological quality of RCTs and NRCTs was assessed using the criteria for concealment of allocation and the Jadad Scale. The quality of observational analytical studies (e.g., prospective and retrospective observational studies, case-control studies, and cross-sectional studies with controls) was assessed using the Newcastle-Ottawa Scales (NOS). The quality of the before-and-after studies was evaluated against four criteria adapted from the NOS.

Two independent reviewers assessed study relevance, extracted the data and assessed the methodological quality of the studies. Disagreements among reviewers were adjudicated by a third reviewer.

Synthesis of the Evidence

Data for topic I on the practice of meditation were synthesized qualitatively. A combination of qualitative and quantitative approaches was used to synthesize the data in Topics II to V. Details of individual studies were summarized in evidence tables including information on the article source, study design, study population (e.g., sample size, age, and gender), treatment groups, and outcomes. Meta-analyses using the standard inverse variance and random effects model were planned to derive pooled estimates from individual studies to support inferences regarding the magnitude and direction of the effect of meditation practices. Forest plots were used to display the individual and pooled results. An analysis of publication bias was also planned.

Results

Topic I. The Practice of Meditation

Five broad categories of meditation practices were identified in the included studies: Mantra meditation (comprising the Transcendental Meditation® technique [TM®], Relaxation Response [RR], and Clinically Standardized Meditation [CSM]), Mindfulness meditation (comprising Vipassana, Zen Buddhist meditation, Mindfulness-based Stress Reduction [MBSR], and Mindfulness-based Cognitive Therapy [MBCT]), Yoga, Tai Chi, and Qi Gong. Given the variety of the practices and the fact that some are single entities (TM®, RR, and CSM, Vipassana, MBSR, and MBCT) while others are broad categories that encompass a variety of different techniques (Yoga, Tai Chi, Qi Gong), it is impossible to select components that might be considered universal or supplemental across practices. Though some statement about the use of breathing is universal among practices, this is not a reflection of a common approach toward breathing. The control of attention is putatively universal; however, there are at least two aspects of attention that might be employed and a wide variety of techniques for anchoring the attention. The spiritual or belief component of meditation practices is poorly described in the literature and it is unclear in what way and to what extent spirituality and belief play a role in the successful practice of meditation. The amount of variation in the described frequency and duration of practice make it difficult to draw generalizations about the training requirements for meditation techniques. The criteria for successful meditation practice have also not been described well in the literature.

Topic II. State of Research on the Therapeutic Use of Meditation Practices in Healthcare

Eight hundred and thirteen studies provided evidence regarding the state of research on the therapeutic use of meditation practices. The studies were published between 1956 and 2005, with half of the studies published after 1994. Most of the studies were published as journal articles. Studies were conducted mainly in North America (61 percent). Of the 813 studies included, 67 percent were intervention studies (286 RCTs, 114 NRCTs and 147 before-and-after studies), and 33 percent were observational analytical studies (149 cohort and 117 cross-sectional studies).

Quality of studies. Overall, we found the methodological quality of meditation research to be poor, with significant threats to validity in every major category of quality measured, regardless of study design. The majority of RCTs did not adequately report the methods of randomization, blinding, withdrawals, and concealment of treatment allocation. Observational studies were subject to bias arising from uncertain representativeness of the target population, inadequate methods for ascertaining exposure and outcome, insufficient followup period, and high or inadequately described losses to followup.

Meditation practices. Mantra meditation practices such as the TM® technique and the RR were the most frequently studied meditation practices. Other mantra practices such as CSM, Acem meditation, Ananda Marga, concentrative prayer, and Cayce's meditation have been examined less frequently. The second category of meditation practices most frequently examined is Yoga. It includes a heterogeneous group of techniques such as Hatha yoga, Kundalini yoga, and Sahaja yoga. Mindfulness meditation, which includes MBSR, MBCT, and Zen Buddhist meditation, constitutes the third most studied group of meditation practices, Tai Chi the fourth, and Qi Gong the fifth. Finally, less than 5 percent of the studies on meditation have failed to explicitly describe the meditation practice.

Control groups. The number of control groups used in the 668 controlled studies ranged from one to four. The majority of the studies utilized an active, concurrent control. Among the RCTs and NRCTs, the practice of exercise and other physical activities constituted the most frequent active comparator followed by conditions involving states of rest and relaxation, health education, and progressive muscle relaxation. Almost half of the RCTs and NRCTs included comparison groups consisting of participants assigned to waiting lists, or participants that did not receive any intervention. The vast majority of observational studies used comparison groups consisting of individuals that had not been exposed to any type of meditation practice.

Study population. The majority of studies on meditation practices have been conducted in healthy populations. The three most studied clinical conditions are hypertension, other cardiovascular diseases, and substance abuse. Other diseases that have been frequently examined include anxiety disorders, depression, cancer, asthma, chronic pain, type II diabetes mellitus, and fibromyalgia.

Outcome measures. Physiological functions, particularly cardiovascular outcomes, were the most frequently reported outcome of interest in meditation research. Psychosocial outcomes, outcomes related to clinical events and health status, cognitive and neuropsychological functions, and healthcare utilization outcomes have also been evaluated in studies of meditation practices.

Topic III. Evidence on the Efficacy and Effectiveness of Meditation Practices

We summarized the evidence from RCTs and NRCTs on the effects of meditation practices for the three most studied clinical conditions identified in the scientific literature: hypertension (27 trials), other cardiovascular diseases (21 trials), and substance abuse disorders (17 trials).

A few studies of overall poor methodological quality were available for each comparison in the meta-analyses, most of which reported nonsignificant results. TM® had no advantage over health education to improve measures of systolic blood pressure and diastolic blood pressure, body weight, heart rate, stress, anger, self-efficacy, cholesterol, dietary intake, and level of physical activity in hypertensive patients; RR was not superior to biofeedback in reducing blood pressure in hypertensive patients; Yoga did not produce clinical or statistically significant effects in blood pressure when compared to nontreatment; Zen Buddhist meditation was no better than blood pressure checks to reduce systolic blood pressure in hypertensive patients. Yoga was no better than physical exercise to reduce body weight in patients with cardiovascular disorders. When the relative effectiveness of a variety of meditation practices was assessed using indirect meta-analysis, we found that there were no significant differences between MBSR and Yoga to control anxiety symptoms in cardiovascular patients. Meta-analysis of the effects of meditation practices for substance abuse was not possible due to the diversity of practices, comparison groups, and outcome measures reported in each of the studies reviewed.

The results of the three highest quality trials (Jadad score = 3/5) examining, respectively, Mindfulness meditation, RR, and Yoga are inconclusive with respect to the effectiveness of meditation pratices.

The study comparing Mindfulness meditation with usual care (NS) for alcohol and cocaine abuse found little indication that Mindfulness meditation enhanced treatment outcomes for substance abuse patients. The study comparing RR with PMR and rest groups for alcohol abuse found generalized effects for BP, but not for the other outcome measures (anxiety, HR, and GSR). The RR and PMR groups did not exhibit increased BP as observed in control subjects. RR and PMR produced significant changes in tension. The study comparing Yoga with exercise for alcohol abuse found a significantly greater recovery rate for the Yoga group.

Statistical and clinical heterogeneity among the trials constituted a frequent and considerable problem when pooling the results, and in some cases, it precluded summarizing data across the studies. The poor methodological quality of the trials limits the strength of inference regarding the observed treatment effects reported in this review. The lack of description of the methods of allocation concealment, randomization, description of withdrawals and dropouts per treatment group, the absence of appropriate blinding , and the use of incompatible or inappropriate control groups undermine the validity of the results of many clinical studies.

Topic IV. Evidence on the Role of Effect Modifiers for the Practice of Meditation

The role of patient or meditation characteristics as effect modifiers in the practice of meditation is a topic that has so far been neglected in the scientific literature. Few studies have systematically examined factors such as dose, duration, or other specific features of meditation as moderators of the effects on outcomes. Evidence from RCTs and NRCTs regarding the interaction of meditation with other variables in populations of patients with hypertension, cardiovascular disorders, or substance abuse is scarce. A few studies conducted exploratory post hoc analyses (i.e., a subgroup analysis, multiple regression, or analysis of variance) that were intended to be hypothesis generating. No conclusions on the role of effect modifiers can be drawn from the analysis of the individual studies. Individual patient data is required to appropriately examine this issue.

TOPIC V. Evidence on the Physiological and Neuropsychological Effects of Meditation Practices

The physiological and neuropsychological effects of meditation practices were evaluated in 311 studies. The majority of studies have been conducted in healthy participants. Meta-analysis revealed that the most consistent and strongest physiological effects of meditation practices in healthy populations occur in the reduction of heart rate, blood pressure, and cholesterol. The strongest neuropsychological effect is in the increase of verbal creativity. There is also some evidence from before-and-after studies to support the hypothesis that certain meditation practices decrease visual reaction time, intraocular pressure, and increase breath holding time. As found in studies included for topic III, the overall low methodological quality of the studies indicates that most of the studies suffered from methodological problems that may result in overestimations of the treatment effects or compromise the generalizability of the study results. Particularly, the lack of a concurrent control group in the before-and-after studies results in an inability to control for temporal trends, regression to the mean, and sensitivity to methodological features. Therefore, results from meta-analyses of the physiological and neuropsychological effects of meditation practices should be interpreted cautiously.

The very small number of trials available for each comparison precluded testing for publication bias.

Future Research

Future research in meditation has several challenges. There is a need to develop a consensus on a working definition of meditation applicable to a heterogeneous group of practices. Another area of future inquiry consists of systematically comparing the effects of different meditation practices that research shows have promise. Special attention to the appropriate selection of controls is also paramount and future research should be directed toward investigating the unique challenges that mediation studies present in designing controls. In addition, more research should be done on the "dose response" of meditation practices to determine appropriate study durations and to help standardize courses of therapeutic meditation.

Because it is difficult to determine causation using uncontrolled before-and-after designs, it is recommended that these study designs be avoided in future research on the effectiveness of meditation practices. Researchers should aim to employ designs and analytic strategies that optimize the ability to make causal inferences (in some cases this may require the use of uncontrolled before-and-after designs). Future studies would benefit from using larger samples and employing concurrent controlled designs, using disease-specific measures and providing clearer descriptions of intervention components. Finally, the quality of reporting of meditation research would be improved by a wider dissemination and stricter enforcement of the CONSORT (Consolidated Standards of Reporting Trials) guidelines within the complementary and alternative medicine community.

Conclusions

The field of research on meditation practices and their therapeutic applications is beset with uncertainty. The therapeutic effects of meditation practices cannot be established based on the current literature. Further research needs to be directed toward the ways in which meditation may be defined, with specific attention paid to the kinds of definitions that are created. A clear conceptual definition of meditation is required and operational definitions should be developed. The lack of high-quality evidence highlights the need for greater care in choosing and describing the interventions, controls, populations, and outcomes under study so that research results may be compared and the effects of meditation practices estimated with greater reliability and validity. Firm conclusions on the effects of meditation practices in healthcare cannot be drawn based on the available evidence. It is imperative that future studies on meditation practices be rigorous in the design, execution, analysis, and reporting of the results

Evidence Report

Chapter 1. Introduction and Background

Meditation has been a spiritual and healing practice in some parts of the world for more than 5,000 years.[1] The word "meditation" is derived from the Latin "meditari," which means "to engage in contemplation or reflection."

Historically, religious or spiritual aims were intrinsic to any form of meditation. These traditional practices held some type of spiritual growth, enlightenment,[2] personal transformation, or transcendental experience as their ultimate goal.[3] During the last 40 years, the practice of meditation has become increasingly popular and has been adapted to the specific interests and orientation of Western culture as a complementary therapeutic strategy for a variety of health-related problems.[2,4] Both secular forms of meditation and forms rooted in religious and spiritual systems have increasingly attracted the interest of clinicians, researchers, and the general public, and have gained acceptance as important mind-body interventions within integrative medicine (the combination of evidence-based conventional and alternative approaches that address the biological, psychological, social, and spiritual aspects of health and illness). With an estimated 10 million practitioners in the United States and hundreds of millions of practitioners worldwide,[5] meditation was the first mind-body intervention to be widely adopted by mainstream healthcare providers and incorporated into a variety of therapeutic programs in hospitals and clinics in the United States and abroad.[6,7]

Definition and Types of Meditation

Meditation has been characterized in many ways in the scientific literature and there is no consensus definition of meditation. This diversity in definitions reflects the complex nature of the practice of meditation and the coexistence of a variety of perspectives that have been adopted to describe and explain the characteristics of the practice. Therefore, we recognize that any single definition limits the practice artificially and fails to account for important nuances that distinguish one type of meditation from another.[8]

Cardoso et al.[9] developed a detailed operational definition of meditation broad enough to include traditional belief-based practices and those that have been developed specifically for use in clinical settings. Using a systematic approach based on consensus techniques, they defined any practice as meditation if it (1) utilizes a specific and clearly defined technique, (2) involves muscle relaxation somewhere during the process, (3) involves logic relaxation (i.e., not "to intend" to analyze the possible psychophysical effects, not "to intend" to judge the possible results, not "to intend" to create any type of expectation regarding the process), (4) a self-induced state, and (5) the use of a self-focus skill or "anchor" for attention. From a cognitive and psychological perspective, Walsh et al.[10] defined meditation as a family of self-regulation practices that aim to bring mental processes under voluntary control through focusing attention and awareness. Other behavioral descriptions emphasize certain components such as relaxation, concentration, an altered state of awareness, suspension of logical thought processes, and maintenance of self-observing attitude.[11] From a more general perspective, Manocha[12] described meditation as a discrete and well-defined experience of a state of "thoughtless awareness" or mental silence, in which the activity of the mind is minimized without reducing the level of alertness. Meditation also has been defined as a self-experience and self-realization exercise.[13]

Despite the lack of consensus in the scientific literature on a definition of meditation, most investigators would agree that meditation implies a form of mental training that requires either stilling or emptying the mind, and that has as its goal a state of “detached observation” in which practitioners are aware of their environment, but do not become involved in thinking about it. All types of meditation practices seem to be based on the concept of self-observation of immediate psychic activity, training one’s level of awareness, and cultivating an attitude of acceptance of process rather than content.[3]

Meditation is an umbrella term that encompasses a family of practices that share some distinctive features, but that vary in important ways in their purpose and practice. This lack of specificity of the concept of meditation precludes developing an exhaustive taxonomy of meditation practices. However, in order to systematically address the question of the state of research of meditation practices in healthcare, we must attempt to identify the components that are common to the many practices that are claimed to be meditation or that incorporate a meditative component, and also clearly distinguish meditation practices from other therapeutic and self-regulation strategies such as self-hypnosis or visualization and from other relaxation techniques that do not contain a meditative component.

Meditation practices may be classified according to certain phenomenological characteristics: the primary goal of practice (therapeutic or spiritual), the direction of the attention (mindfulness, concentrative, and practices that shift between the field or background perception and experience and an object within the field[3,14]), the kind of anchor employed (a word, breath, sound, object or sensation[7,15,16]), and according to the posture used (motionless sitting or moving).[7] Like other complex and multifaceted therapeutic interventions, meditation practices involve a mixture of specific and vaguely defined characteristics, and they can be practiced on their own or in conjunction with other therapies. As pointed out by many authors, any attempt to create a taxonomy of meditation only approximates the multidimensional experience of the practices.[17]

Meditation Practices as a Part of Healing and Healthcare

The interest in meditation practices as healing strategies comes with the need to acquire a deeper knowledge of the intricate connections between body and mind, and how the mental and spiritual state of an individual directly affects psychological and physical well-being. Meditation practices have been advocated as mind-body treatments for health-related problems and as methods to attain or maintain general wellness. There is a growing body of scientific literature on the effects of meditation practices for a variety of psychiatric disorders such as depression,[18] anxiety,[14,19] panic disorders,[20] binge eating disorders,[7] and substance abuse[21,22] among others. Effects of meditation practices have been also documented using measures of emotional distress[20] and cognitive abilities.[23]

The effects of meditation practices as complementary treatments for medical conditions other than mental illness have been evaluated using a variety of methods and outcomes. These clinical conditions include hypertension[24] and other cardiovascular disorders,[25,26] pain syndromes and musculoskeletal diseases,[18,27,28] respiratory disorders (e.g., asthma, congestive obstructive pulmonary disease),[29] dermatological problems (e.g., psoriasis, allergies),[30] immunological disorders,[27] and treatment-related symptoms of breast and prostate cancer.[18,31]

There is also a considerable interest in understanding the physiological and neuropsychological effects of certain meditation practices.[3,32,33] Research conducted in this area has used a variety of methodological approaches and formal evaluations of the methodological quality of this body of evidence have not been conducted.

There is a need to evaluate the evidence that has emerged within the past several decades on the effects of meditation practices in healthcare. Reports on the therapeutic effects of a variety of meditation practices vary greatly across studies. Numerous authors have claimed that most of the studies in this area are methodologically flawed and often have small sample sizes.[3,34,35] The magnitude and direction of the effect often varies from one type of practice to another; however, authors agree that some meditation practices hold some promise of therapeutic benefit for a variety of diseases or conditions. Therefore, there is a great need to clarify and address a host of clinical and research questions regarding the benefits of these interventions.

It is also important to systematically evaluate the role that effect modifiers (e.g., age, gender, duration of practice, other characteristics of meditators, training conditions) may have in influencing the outcomes of the types of meditation. By elucidating important clinical questions regarding the therapeutic effects of meditation practices, consensus on standards of practice can be reached with a view to integrate mind-body approaches more effectively into conventional medical care.

Objectives of the Review

- To provide a descriptive overview and synthesis of information on meditation practices in terms of the main components of the practice, the role of spirituality, training requirements, and criteria for success.
- To conduct a systematic review and synthesis of the evidence on (1) the state of research on the therapeutic use of meditation practices in healthcare, (2) the efficacy and effectiveness of meditation practices in healthcare, (3) the role of effect modifiers for the practices, and (4) the effects of meditation practices on physiological and neuropsychological outcomes.

Chapter 2. Methods

Overview

In this chapter we document a prospectively designed protocol that the University of Alberta Evidence-based Practice Center (UAEPC) used to develop this comprehensive evidence report on the state of research of meditation practices in healthcare.

To accomplish the tasks as directed, a core research team at the UAEPC was assembled to review and refine the methodology of the task order. All the reviewers at the UAEPC are trained and experienced in systematic review methodology and critical analysis of the scientific literature. In consultation with the Agency for Healthcare Research and Quality (AHRQ) Task Order Officer (TOO) and National Center for Complementary and Alternative Medicine (NCCAM) representatives, a Technical Expert Panel (TEP) was invited to provide high-level content and methodological expertise in the development of the report. The list of technical experts and their curriculum vitae were submitted to the AHRQ TOO for approval (Appendix A).[*]

Throughout the development of the report, the UAEPC project staff worked closely with TEP members and AHRQ and NCCAM representatives to refine the research questions. Guidance was provided through a series of teleconferences and, when needed, through individual telephone calls and e-mail.

To provide a framework for the report, we first present the key questions of the review and our analytic approach to address them. We then describe the literature review methods, including a description of how we developed a set of parameters to describe meditation practices. We outline our inclusion and exclusion criteria, the search strategy for identifying articles relevant to the key questions, and the process for abstracting and synthesizing information from eligible studies. We also describe the methods for assessing the methodological quality of individual studies and the criteria for evaluating the strength of the evidence as a whole. The methods for data analysis and synthesis and the peer review process are described at the end of the chapter.

Key Questions and Analytic Approach

The key questions of this review have been organized under five general topics:

Topic I. The Practice of Meditation

The following questions pertain to the description of the practice of meditation and meditation techniques:

1. What is known about the practice of meditation?

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[*] Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

a. What are the main components of the various meditation practices (e.g., breathing, chanting, mantras, and relaxation)? Which components are universal and which ones are supplemental?
b. How is breathing incorporated in these practices? Are there specific breathing patterns that are integral elements of meditation? Is breathing passive or directed?
c. For each type of meditation practice, where is the attention directed during meditation (e.g., mantra, breath, image, nothing)?
d. To what extent is spirituality a part of meditation? To what extent is belief a part of meditation?
e. What are the training requirements for the various meditation practices (e.g., the range of training periods, frequency of training, individual and group approaches)
f. How is the success of the meditation practice determined (i.e., was it practiced properly)? What criteria are used to determine successful meditation practice?

Topic II. State of Research on the Therapeutic Use of Meditation Practices in Healthcare

The following key questions pertain to the scope of research on meditation in healthcare:

2. What meditation practices have been examined in clinical trials and observational studies? What control groups are used?
3. Can these practices be separated by the diseases, conditions, and populations for which they have been examined?
4. What outcome measures are used? Are psychosocial outcomes included in these studies? If so, what types?

Topic III. Evidence on the Efficacy and Effectiveness of Meditation Practices

The following key questions pertain to the potential benefits and harms of meditation:

5. What is the evidence that meditation practices are efficacious for the three most studied diseases or conditions identified in question 2 above?
6. If more than one form of meditation has been studied for a particular disease or condition (as identified in question 2 above), does the efficacy of these practices differ?
7. For specific disease populations, are meditation practices that are used as a complement to conventional therapy more effective than either the conventional therapy or meditation therapy alone?

Topic IV. Evidence on the Role of Effect Modifiers for Meditation Practices

The following key questions pertain to specific elements of the meditation practice, population and practitioner that may influence the outcomes:

8. What dose of meditation is necessary before successful health outcomes are realized? That is, is the duration of meditation important for outcomes?
9. Does the direction of attention during meditation affect outcomes?
10. To what extent is a rhythmic aspect (i.e., mantra, controlled breathing, or other ordered, recurrent sound or motion) critical to the practice of meditation and to health outcomes? Do such approaches to meditation that rely on these rhythmic behaviors demonstrate consistent effectiveness versus nonrhythmic approaches to meditation? More broadly, do the number and types of components that make up the various meditation practices influence the outcomes?
11. Do individual difference variables (age, gender, race, education, income, other) predict success in the process of meditation (i.e., adherence, acceptance), as well as predicting health outcomes?

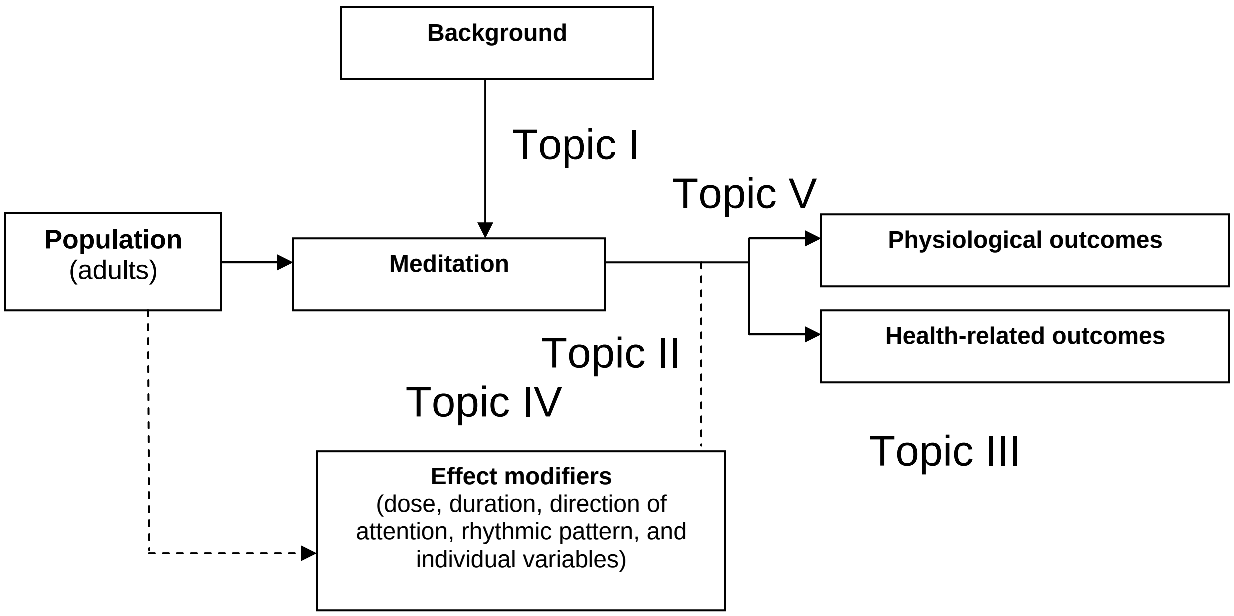
Topic V. Evidence on the Physiological and Neuropsychological Effects of Meditation Practices

The following key questions pertain to the physiological and neuropsychological effects of meditation practices:

12. What is known regarding cardiopulmonary, endocrine, immunologic, metabolic, and autonomic changes seen during meditation practices?
13. What is known regarding the effects of meditation practices on brain function (e.g., brain imaging, electroencephalogram (EEG), neuropsychological and cognitive functions)?

Figure 1 presents the analytic framework for the review. We used two main methodological approaches to address the research topics discussed in this report.

Figure 1. Analytic framework for evidence report on the state of research on meditation practices in healthcare



For topic I, the practice of meditation, the steps involved in the development of the descriptive overview included:

- development of an operational definition of meditation
- literature search
- study selection
- data extraction
- qualitative synthesis of information

For topic II on the state of research for the therapeutic use of meditation practices, topic III on the efficacy and effectiveness of meditation practices, topic IV on the role of effect modifiers of meditation practices, and topic V on the physiological and neuropsychological effects of meditation practices, a number of steps were involved in conducting the literature review and synthesis of the evidence:

- literature search and retrieval
- study selection
- assessment of study quality
- data extraction
- data analysis and synthesis

Literature Review Methods

Development of Operational Parameters to Define Meditation Practices

There is no consensus on a definition of meditation in the scientific literature. For the purposes of this report, a set of parameters to describe meditation practices was developed using a modified Delphi methodology.[36,37] The systematic process used to reach consensus on the operational definition of meditation was documented and is described briefly below (Appendix B).[1]

A first-round questionnaire was distributed to TEP members to solicit their opinion on a set of parameters extracted from the scientific literature to describe meditation. Participants independently rated the importance of each parameter to characterize a practice as meditation. They were also asked to suggest other parameters not included in the questionnaire that they considered important. A feedback summary from the first-round responses was sent to TEP members along with a second-round questionnaire. In light of round-one group responses, participants were asked if they would reconsider their first-round responses. The process stopped when consensus among participants was reached. Responses to questions were analyzed and categorized by frequency of endorsement. Consensus was defined as agreement on a value or category by 80 percent of the Delphi participants.[37] If consensus was not reached by the Delphi technique, the TEP convened and group consensus techniques were used in a teleconference.

Literature Search and Retrieval

Databases and search terms. The research librarian worked closely with the TEP to refine search strategies for all questions of the review. Comprehensive searches were conducted of the electronic databases listed in Table 1 for the time periods specified. The order of the databases in Table 1 is the sequence in which the databases were searched (Appendix C).[*]

Table 1. Databases searched for relevant studies

Database	Date of search	Years/issue searched
Cochrane Central Register of Controlled Trials	August 4, 2005	3rd Quarter 2005
CSA Neurosciences Abstracts	August 4, 2005	1982-2005
MEDLINE® and PreMedline®	September 8, 2005	1966 to August, 2005; Week 5
Old Medline	February 21, 2006	1950-1965
EMBASE	September 8, 2005	1988 to 2005; Week 36
Cochrane Database of Systematic Reviews	September 9, 2005	3rd Quarter 2005
PsycINFO®	September 9, 2005	1872 to August, 2005; Week 4
Web of Science®	September 21, 2005	1900-2005

[*]Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Table 1. Databases searched for relevant studies (continued)

Database	Date of search	Years/issue searched
OCLC FirstSearch (Articles and Proceedings)	September 22, 2005	1993-2005
AMED	September 30, 2005	1985 to September, 2005
CINAHL®	October 4, 2005	1982 to September Week 5, 2005
Cochrane Complementary Medicine Trials Register	October 25, 2005	1943-2003
CAMPAIN (Complementary and Alternative Medicine and Pain Database)	October 25, 2005	1983-2003
NLM® Gateway	October 25, 2005	1950-2005
Current Controlled Trials - BioMed Central	October 24, 2005	1998-2005
National Research Register	October 24, 2005	2000-2005
CRISP	February 21, 2006	2005-2006

In addition to the electronic databases, the following journals and collections were hand searched: *International Journal of Behavioral Medicine* (1994–2005), *Scientific Research on The Transcendental Meditation® Program: Collected Papers* (Volumes 1 to 4), *Journal of Bodywork & Movement Therapies* (1996–2005), *Journal for Meditation and Meditation Research* (2001–2003), *International Journal of Yoga Therapy* (1997–2005), and *Explore: The Journal of Science and Healing* (2005).

The reference lists of relevant studies (e.g., included studies, other systematic or narrative reviews) were reviewed to identify potentially relevant studies. Gray literature was searched to identify unpublished studies and works in progress. Scientific abstracts from the Society of Behavioral Medicine (2005) and the American Psychosomatic Society (1999-2005) annual scientific meetings were reviewed. The National Research Register from the National Health Service was searched for ongoing trials. Primary authors of potentially eligible ongoing studies were contacted if this was necessary to clarify whether those studies did indeed meet the inclusion criteria. TEP members were also requested to provide additional information about potentially relevant studies.

Criteria for Selection of Studies

A set of strict eligibility criteria was used to determine the inclusion and exclusion of studies for the report. The inclusion criteria for topic I are documented in Table 2. It is important to emphasize that the review on Topic I does not constitute a manual for any meditation practice. A more detailed explanation of any specific meditation practice described in this report should be sought in specialized texts or from master practitioners.

Information from primary studies and other original research identified for topics II to V was considered for topic I if it provided a detailed description of the meditation practice under study according to the parameters defined by the Delphi process.

Table 2. Inclusion criteria for topic I

Category	Criteria
Source	English-language scientific literature
Population	Adults (i.e., individuals aged ≥ 18 years)
Intervention	Empirical description of meditation practice according to the parameters defined by the TEP in the Delphi process
Study design	Systematic reviews, narrative reviews, book chapters and other sources of secondary data
Outcomes of interest	Components of meditation practices (e.g., breathing, chanting, mantras, relaxation) Role of breathing Role of attention Role of belief/spirituality Training conditions Criteria for success

Our inclusion criteria for topics II to V are documented in Table 3. Some criteria are common to all of these topics, but some criteria were specifically developed for inclusion of studies in topics III and IV only. We sought to match the type of evidence required to the nature of the questions and to identify the highest quality of evidence appropriate to answer each group of questions. For topics III and IV on the efficacy and effectiveness of meditation practices, and on the role of effect modifiers for meditation practices, we looked for evidence from randomized controlled clinical trials (RCTs) and nonrandomized controlled clinical trials (NRCTs). No restrictions were applied for setting or geographical location of the studies. Only studies published in the English language were eligible according to the scope outlined by NCCAM for this review.

Table 3. Inclusion criteria for topics II to V

Category	Criteria
Source	Primary research report published in English
Population	Adults (i.e., individuals aged ≥ 18 years) Normal (topics II and V only) and clinical populations (topics II to V) No previous meditation practice
Intervention	Any meditation practice according to the parameters provided by the TEP in the Delphi study
Sample size	N greater than 10
Study design	Studies including a comparison/control group or control period in the methodological design: RCTs, NRCTs (topics III to V), prospective and retrospective observational studies with controls (topic II), case-control studies (topic II), uncontrolled before-and-after studies (topics II and V), and cross-sectional studies with controls (topics II)
Outcomes of interest	Measurable data for health related outcomes

Study Selection Process

Screening of titles and abstracts. We developed a predefined set of broad criteria to apply to the results of the literature searches to ensure that potentially relevant articles were not excluded early in the selection process (Appendix D).[2] Four independent reviewers evaluated the title and abstract of each study to select references potentially relevant to the topics of the report. The full-text of studies meeting the criteria was retrieved as was the full-text of those that reported insufficient information to determine eligibility.

Identification of studies eligible for the review. Two independent reviewers appraised the full-text of potentially relevant articles using a standard form that outlined the inclusion and exclusion criteria for each research topic (Appendix D).[*] Decisions regarding inclusion and exclusion and the reasons for exclusion were documented.

The level of agreement among reviewers at all stages of the selection process was evaluated using the Kappa (κ) statistic.[38] A κ score in the range from 0.0 to 0.40 was considered poor agreement; 0.41 to 0.60 moderate agreement; and 0.61 to 0.80 substantial agreement.[39] Disagreements about the inclusion or exclusion of studies were resolved by consensus. When consensus was not reached, a decision was made in consultation with the TEP.

Evaluating the Methodological Quality of Studies

Rating the quality of individual articles. Studies included in the descriptive overview on the practice of meditation (topic I) were not assessed for methodological quality; therefore, the following methods for quality assessment apply to studies meeting eligibility criteria for topics II to V only.

Quality of intervention studies (RCTs, NRCTs, and before-and-after studies). The methodological quality of RCTs was assessed using the criteria for concealment of allocation[40,41] and the Jadad scale.[42] The former is based on the evidence of a strong relationship between the potential for bias in the results and allocation concealment: failure to conceal the process of treatment allocation can undermine randomization and, consequently, a selection bias may occur.[40] The Jadad scale is a validated scale that includes questions related to bias reduction: randomization, double-blinding and description of dropouts and withdrawals. This tool scores quality from 0 to 5. Studies scoring less than 3 points are usually considered to be of low quality.[42] The psychometric properties of the Jadad scale have been thoroughly tested, providing rigorous evidence to support its use.[42,43] We used individual components of the Jadad scale to create a 3-point scale based on blinding and participant attrition to assess the methodological quality of NRCTs.

No completely or partially validated instruments are available to assess the methodological quality of uncontrolled before-and-after studies. Quality of reporting of uncontrolled before-and-after studies included in topics II and V was evaluated with four questions assessing whether the study participants were representative of the target population, the method of outcome assessment was the same for the pre- and postintervention periods for all participants, outcome assessors were blind to the intervention and the purpose of study, and the number of and reasons for study withdrawals were reported.

Quality of observational analytical studies. The methodological quality of observational analytical studies (i.e., prospective and retrospective observational studies, case-control studies, and cross-sectional studies with controls) was assessed using the Newcastle-Ottawa Scales

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[*]Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

(NOS).[44] These are eight-item instruments that use a star system to assess methodological quality across three categories: the methods of selecting the study groups, their comparability, and the ascertainment of the outcome of interest. Scores range from 0 to 9 stars. The NOS scales have been recommended by the Cochrane Nonrandomized Studies Methods Working Group, and studies on their psychometric properties are in progress.[44]

The assessment of quality of observational studies is more difficult than the assessment of RCTs and NRCTs. Empirical research has shown that numeric scores based on arbitrary weights given to each item in a scale are unreliable and difficult to interpret.[45] Therefore, we decided to describe the methodological quality of observational analytical studies using the individual components of the NOS scales.

Finally, information regarding the source of funding was collected for all the included studies.[46]

Two reviewers assessed the methodological quality of studies independently. Disagreements were resolved by consensus or, when no consensus could be reached, a senior methods expert adjudicated (Appendix D).*

Data Collection

For topic I on the practice of meditation, a single reviewer extracted information that was organized according to narrative categories (e.g., components of the meditation practices, role of breathing and spirituality, training requirements, and criteria for success) to allow for a systematic description of the meditation practices considered in this report.

For topics II to V, trained research staff at the UAEPC extracted the information. A comprehensive and pretested data extraction form and guidelines explaining the extraction criteria were developed (Appendix D)*. Information regarding the study design and methods, the characteristics of participants, interventions, comparison groups, and outcomes of interest were extracted. Data collection on study design and methods included information on the country and year of publication, type of publication, objective of the study, study design, duration, number of centers, and source of funding. Data on characteristics of the participants included setting of the study, type of primary health problem or health condition of study participants, and diagnostic criteria (as reported by the authors of the studies). Data on characteristics of the intervention (i.e., meditation practices) included a description of the practice in terms of components, content and format, frequency, and intensity. Likewise, data on the characteristics of the control group included a description of the components, content, and format. Finally, information was extracted on the type of outcomes and on the units or instruments of measurement for each outcome. A single reviewer extracted the data from the primary studies and another independent reviewer verified the accuracy and completeness of the data. Any discrepancies in data extraction were solved by consensus between the data extractor and the data verifier. During this process, the reviewers consulted with TEP members both for content and methodological advice as needed.

Study selection, methodological quality assessment, and data extraction were managed with the Systematic Review Software™ (SRS), version 3.0 (TrialStat!; Ottawa, ON). Graph extraction was performed using Corel Draw®, version 9.0 (Vector Capital, San Francisco, CA). Extracted

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

data were exported into Microsoft Excel™ (Microsoft Corporation, Redmond, WA) spreadsheets.

Literature Synthesis

Data Analysis and Synthesis

Classification of the meditation practices. The first step in synthesizing the data for topics I to V was to create categories of analysis for the meditation practices described in the scientific literature. Based on data from the Delphi study, input from the TEP members, and a review of the literature, a set of seven categories was constructed to classify the meditation practices. Two independent researchers coded each study according to this classification scheme. Coding was discussed between researchers on a study-by-study basis. Coding discrepancies were resolved by consulting the original research study.

The following seven categories were used for data synthesis for topics II to V:

Mantra meditation. This category comprises meditation practices in which a main element of practice is mantra: the Relaxation Response technique (Relaxation Response or RR), the Transcendental Meditation® technique (hereafter, simply "Transcendental Meditation®" or "TM®"), Clinically Standardized Meditation (CSM), Acem meditation, Ananda Marga, and other concentrative practices that involve the use of a mantra such as Rosary prayer, and the Cayce method.

Mindfulness meditation. Though described slightly differently by Eastern and Western interpreters, this category refers generally to meditation practices that cultivate awareness, acceptance, nonjudgment, and require paying attention to the present moment.[47-49] This category includes Mindfulness-Based Stress Reduction (MBSR), Mindfulness-Based Cognitive Therapy (MBCT), Vipassana meditation, Zen Buddhist meditation, and other mindfulness meditation practices not further described.

Qi Gong. This category refers to an ancient practice from traditional Chinese medicine that combines the coordination of different breathing patterns with various physical postures, bodily movements, and meditation. External Qi Gong, in which a trained practitioner directs his or her own *qi* outward, with the intention of helping patients clear blockages, remove negative *qi* and balance the flow of *qi* in the body, to help the body rid itself of certain diseases is not a form of meditation according to the working definition developed for this report.

Tai Chi. This category describes a Chinese martial art characterized by soft, slow, flowing movements that emphasize force and complete relaxation. It has been also called "meditation in motion."

Yoga. This category includes a broad group of techniques rooted in yogic tradition that incorporate postures, breath control, and meditation. It includes practices such as Hatha yoga, Kundalini yoga, and individual components of Yoga such as pranayama (breath control exercises).

Miscellaneous meditation practices. This category describes techniques that combine different approaches to meditation in a single intervention, without giving prominence to one. It includes combined practices such as Yoga plus RR, TM® and Buddhist Meditation, and RR plus

Mindfulness meditation. The category was also used to describe meditation practices that do not fall within any of the other categories (e.g., coloring mandalas).

Meditation practices (not described). This category refers to meditation practices that were not described in sufficient detail to allow them to be assigned to a more specific category, including techniques that were described by vague terminology such as “meditation,” “movement meditation,” and “concentrative meditation.”

Topic I. Data for topic I on the practice of meditation were synthesized qualitatively. Information was presented in a structured format, with narrative categories of interest for the different practices of meditation identified in the scientific literature. Once categorized, the similarities and differences among the various meditation practices could be appraised. Categories of analysis include the main components of the meditation practices, the role of breathing, attention, and spirituality, the training requirements, and the criteria of success for the various meditation practices.

Topic II. Data collected for topic II on the state of research for the therapeutic use of meditation practices were summarized using descriptive statistics (e.g., proportions and percentages for categorical data, means with standard deviations [SD], or medians with interquartile ranges [IQR], for continuous data). Evidence and summary tables were constructed to summarize relevant characteristics of the included studies. Data from the included studies were synthesized qualitatively. We used the systematic approach of the Cochrane Collaboration for the synthesis of the evidence.[50] The basic conceptual framework of the qualitative synthesis for topic II focused on the types of meditation practices that have been examined in intervention studies (RCTs, NRCTs, and uncontrolled before-and-after studies) and observational analytical studies (cohort studies, case-control studies, and cross-sectional studies), the types of control groups, the populations, and the types of outcome measures that have been examined in the included studies.

Topics III and IV. Based on the results of topic II describing the populations that have been examined, RCTs and NRCTs assessing the effects of meditation practices for the three most studied clinical conditions were included in the analyses of efficacy and effectiveness of meditation practices (topic III) and the role of effect modifiers for meditation practices (topic IV). The first step in synthesizing the data for topics III and IV was to construct evidence tables that included information on each article’s source, study design, study population (e.g., sample size, age, and gender), treatment groups, and outcomes. The evidence tables also included summaries of study quality and comments to help interpret the outcomes.

Meta-analyses were planned as part of the data analysis to derive pooled estimates from individual studies to support inferences regarding the magnitude and direction of the effect of the meditation practices. If studies evaluating specific meditation practices were sufficiently similar, effect sizes were combined and weighted using the standard inverse variance method[51] to produce an overall effect size for a given outcome. Meta-analyses used a random effects model. In this method, study means are averaged, weighting by a combination of inverse variance augmented by heterogeneity.

The types of summary statistics considered were risk ratios (RR) or odds ratios (OR) with 95 percent confidence intervals (95% CI) for dichotomous outcomes and weighted or standardized mean differences (WMD and SMD, respectively) with 95% CI for continuous outcomes.[52] WMD was chosen as the default method, with SMD being used only when units for the outcome were different among the studies being compared (i.e., stress measured on different scales).[50,53] Hedges adjusted g was used as the SD estimate when the SMD was used.[54] If the means were not reported, they were either imputed from medians or discarded from meta-analysis if neither mean nor median was available. Occasionally studies did not report SDs of their estimates. In these cases, we determined the SD exactly from confidence intervals or exact p-values; estimated the SD from upper-bound p-values, interquartile ranges, ranges, or exact nonparametric p-values; or imputed from other studies reporting similar outcomes in a similar population. All the meta-analyses used endpoint data or change from baseline to endpoint data instead of using the average of separate mean changes calculated at different intervals of time. Forest plots were used to display the individual and pooled results.

Since some common outcomes were reported for many interventions, indirect comparisons[55] were made of these active interventions. This type of comparison involves taking the differences between the differences derived from separate meta-analyses. For example, by taking the difference between the derived meta-analysis of A versus B, and the derived meta-analysis of A versus C an estimate of the comparison of B versus C can be obtained. For some outcomes, when more than four interventions could be compared indirectly, a mixed treatment comparison was conducted. Indirect comparisons are a valid approach to meta-analysis when there is insufficient direct evidence from randomized trials reporting head-to-head comparisons between interventions.[55,56]

In this method, a Bayesian formulation of the data is employed. The differences between each intervention and a baseline intervention (in this case, “no treatment” was chosen as the baseline) are modeled by choosing a prior distribution for the effect and combining this prior value with the data from the studies to arrive at a posterior estimate and 95% credible interval. Such an estimate was obtained for all pairwise comparisons of interventions as well as the comparisons to the baseline intervention. Since the resulting posterior distributions are too complex for direct computation, a Markov Chain Monte Carlo simulation[57] was used to obtain the posterior estimates. This procedure involved simulating the unconditional, unknown posterior distribution by sampling many times from the conditional distribution and averaging the results. We used a sample of 20,000 burn-in iterations followed by 200,000 samples and noninformative normal (point estimate) and uniform (variance estimate) priors to obtain the distributions. We also computed a statistic to estimate the probability that each intervention was the best (e.g., lowered blood pressure the most) by recording the best intervention at each iteration. This simulation was performed using the WinBUGS software, version 1.4 (MRC Biostatistics Unit, Cambridge, United Kingdom).

We tested for statistical heterogeneity using the chi-square test[51] and quantified it using the I^2 statistic.[58] When there was evidence of clinical or statistical heterogeneity among studies, effect size estimates with corresponding 95% CI were presented separately for each study.[59,60] Sources of heterogeneity were explored qualitatively. They may be methodological (differences in design or quality), or clinical (differences in key characteristics of participants, interventions, or outcome measures).[61] Where appropriate, subgroup analysis based on patient, intervention, and study characteristics were conducted and sensitivity analysis based on study quality (Jadad score of greater than and equal to 3 points or less than 3 points) were conducted to assess the effect of quality on precision of the pooled estimates if the number of studies per comparison allowed it.[62]

Two analytic strategies were considered for topic IV on the effect modifiers of meditation practices. First, a meta-regression analysis using RCT-level covariates was planned to explore whether certain characteristics of the participants (e.g., age, gender, ethnicity, education, and income) or the interventions (e.g., dose, frequency, and duration) were associated with increased benefits of meditation practices. The outcome (or dependent) variable in the meta-regression analyses would be the pooled effect size (log OR for binary outcomes, or WMD or SMD for continuous outcomes). If a meta-regression was not feasible due to a small number of trials, or limited data from primary studies, subgroup analyses would be conducted based on participant or intervention characteristics.

Topic V. Based on the types of outcomes identified in topic II, RCTs, NRCTs, and uncontrolled before-and-after studies (i.e., without a parallel control group) were included in the analysis of the physiological and cognitive/neuropsychological effects of meditation practices. Evidence tables were constructed to summarize each article's source, study design, study population (e.g., setting, sample size, age, and gender), treatment groups, and outcomes. The evidence tables also included summaries of the strength of the evidence, study quality, and comments to help interpret the outcomes.

Meta-analyses of RCTs and NRCTs using the methods described above for topic III were also planned for topic V. For studies with pre- and post-measures, data on change from baseline were used if available; otherwise, endpoint data were used. If meta-analytic methods were not feasible, effect size estimates with corresponding 95% CIs were presented separately for each study.[59,60] Data from uncontrolled before-and-after studies were analyzed separately, and, if appropriate, the individual estimates of the treatment effect were pooled using the generic inverse variance method. Sensitivity analyses were conducted to assess the robustness of the findings when necessary. Data were displayed using forest plots.

Publication bias. Publication bias, or the selective publication of research depending on the results, was assessed using funnel plots, and the trim and fill method[63] if enough data were available from the meta-analyses. Funnel plots of effect sizes (axis X) against the SD (axis Y) for each meta-analysis were examined to identify gaps suggesting publication bias. Finally, the trim and fill method provided estimates of the number of studies potentially missing from a meta-analysis and the effect these omissions might have had on its outcome.

All analyses were performed using SAS/STAT® software version 9.1 (SAS Institute Inc., Cary, NC), Statistical Package for the Social Sciences® for Windows® (SPSS® version 14.1, SPSS Inc., Chicago, IL), and RevMan version 4.1 (Cochrane Collaboration, Oxford, UK).

Potential limitations, conclusions, and implications for future practice and research were discussed. The results were interpreted in light of the heterogeneity of the individual studies (e.g., differences in design, study populations, interventions or exposures, and outcome measures) and any evidence of publication bias, if present. Recommendations for practitioners and researchers were based solely on the evidence available.

Peer Review Process

During the course of the study, the UAEPC created a list of 18 potential peer reviewers and sent it to the AHRQ TOO and NCCAM representatives for approval. In May and June 2006, the individuals on the list were approached by the UAEPC and asked if they would act as peer reviewers for this evidence report. Seven experts agreed to act as peer reviewers (Appendix A)* and were sent a copy of the draft report and guidelines for review (Appendix D6).* Reviewers had one month in which to provide critical feedback. Replies were requested in a word processing document, though comments were also accepted by email and telephone. The

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

reviewers’ comments were placed in a table and common criticisms were identified by the authors. All comments and authors’ replies were submitted to the AHRQ for assessment and approval. As appropriate, the draft report was amended based on reviewer comments and a final report was produced.

Chapter 3. Results

In this chapter, the main results of the systematic review are presented according to the five topics that were addressed. The results for topic II, the state of research for the therapeutic use of meditation practices, contain all eligible studies. Studies were then selected from this larger set to address topics III to V (see chapter two on Methods).

Topic I. The Practice of Meditation

Main Components

The main components of any meditation practice or technique refer to its most general features. These may include specific postures (including the position of the eyes and tongue), the use of a mantra, breathing, a focus of attention, and an accompanying belief system. Posture refers to the position of the body assumed for the purpose of meditation. Though traditional meditation practices prescribe particular postures (e.g., the lotus position), postures vary between practices with the only limitation being that the posture does not encourage sleep.[64] Because accounts of most meditation practices describe explicitly the use and role of breathing, mantra, attention, spirituality and belief, training, and criteria for successful meditation practice, these topics are described individually.

Breathing. Breathing in meditation can be incorporated passively or actively. In passive breathing, no conscious control is exerted over inhalation and exhalation and breathing is "natural." In contrast, active breathing involves the conscious control over inhalation and exhalation. This may involve controlling the way in which air is drawn in (e.g., through the mouth or nostrils), the rate (e.g., drawn in quickly or over a specified length of time), the depth (e.g., shallow or deep), and the control of other body parts (e.g., relaxation of the abdomen).

Mantra. A distinctive feature of some meditation practices is the use of a mantra. A mantra is a sound, word, or phrase that is recited repetitively, usually in an unvarying tone, and used as an object of concentration. The mantra may be chanted aloud, or recited silently. Mantras can be associated with particular historical or archetypal figures from spiritual or religious systems, or they may have no such associations.[65]

Relaxation. Relaxation is often considered to be one of the defining characteristics of meditation practices and meditation itself is often considered to be a relaxation technique.[66-68] Indeed, it has been suggested that the popularity of meditation practices in the West is due, at least in part, to the widely accepted plausibility of their alleged effects with respect to arousal reduction.[69] Some researchers have attempted to draw a distinction between relaxation and meditation practices on the basis of intention.[70]

Attention and its object. The intentional self-regulation of attention is considered crucial to the practice of meditation, as is the development of an awareness in which thoughts do not necessarily disappear, but are simply not encouraged by dwelling on them, a state of so-called "thoughtless awareness."[71,72] Some meditation practices focus attention on a singular external object (e.g., mandala, candle, flame), sound (e.g., breath), word or phrase (i.e., mantra), or body part (e.g., the tip of the nose, the space between the eyebrows).[71] In contrast, “mindfulness” meditation techniques aim to cultivate an objective openness to whatever comes into awareness (e.g., by paying attention to simple and repetitive activities or to the sensations of the body). In doing so, the breath may be used as an anchor (but not a focal point) to keep the meditator engaged with the present moment.[65,73] Each of these techniques serves, in a different way, to discourage logical and conceptual thinking.[65]

Spirituality and belief. This component refers to the extent to which spirituality and belief systems are a part of meditation practices. Spirituality and belief systems are composed of metaphysical concepts and the rules or guidelines for behavior (e.g., devotional practices or interpersonal relations) that are based on these concepts.

Training. Training refers to the recommended frequency and duration of periods of practice, and how long a practitioner is expected to train before being considered proficient in a given technique.

Criteria of successful meditation practice. The criteria of successful meditation practice are understood both in terms of the successful practice of a specific technique (i.e., is the technique being practiced properly) and in terms of achieving the aim of the meditation practice (e.g., has practice led to reduced stress, calmness of mind, or spiritual enlightenment).

Five broad categories of meditation practices were identified in the scientific literature: mantra meditation (comprising Transcendental Meditation® [TM®], Relaxation Response [RR], and Clinically Stadardized Meditation [CSM]), mindfulness meditation (comprising Vipassana, Zen Buddhist meditation, Mindfulness-based Stress Reduction [MBSR], and Mindfulness-based Cognitive Therapy [MBCT]), Yoga, Tai Chi, and Qi Gong. These broad categories were used for descriptive purposes throughout the report to address the key research questions.

Mantra Meditation

The distinctive characteristic of the meditation practices included in this category is the use of a mantra. A mantra is a word or phrase repeated aloud or silently and used to focus attention. A mantra often has a smooth sound, for example, the mantras “Om” or “Mu.”[74] It is thought that these sounds produce vibrations that have different effects on people, and these vibrations can be described qualitatively or quantitatively.[62,75] The three mantra meditation practices described below consist of standardized techniques; that is, the techniques have been described systematically in manuals and are relatively invariant wherever, whenever, and by whomever they are taught.[23]

Transcendental Meditation®

TM® is a technique derived from the Vedic tradition of India by Maharishi Mahesh Yogi.[76] In TM®, a meditative state is purportedly achieved in which the repetition of the mantra no longer consciously occurs and instead the mind is quiet and without thought.[77] During the practice of TM®, the ordinary thinking process is said to be "transcended" (or gone beyond) as the awareness gradually settles down and is eventually freed of all mental content, remaining silently awake within itself, and producing a psychophysiological state of "restful alertness."[78,79] These periods, referred to as pure consciousness or transcendental consciousness, are said to be characterized by the experience of perfect stillness, rest, stability, order, and by a complete absence of mental boundaries.[80]

Main components. In the TM® technique, the meditation state is achieved by the repetition of a mantra. The mantra is a meaningless sound from the ancient Vedic tradition and is given to the meditator by an instructor in the TM® technique.[81,82] TM® practitioners sit in a comfortable posture, with eyes closed, and silently repeat the mantra.[83] Though there are reports of the components of the mantras and how they are assigned, it is difficult to confirm these reports as many of the details of practice, including mantras, are revealed only to those who have formal instruction in TM®. Instruction in the TM® technique is a systematic, but individualized process. It is believed that keeping the techniques confidential prevents students from having preconceptions about the technique (making the learning process simpler) and that it maintains the integrity of the technique across generations.

Breathing. TM® involves passive breathing; no breath control procedures are employed and no specific pattern is prescribed.[80]

Attention and its object. TM® is described as not requiring any strenuous effort, concentration, or contemplation.[80,84] However, meditators are instructed to direct their attention to the mantra.[83]

Spirituality and belief. The TM® technique has a theoretical framework that is described in Maharishi Mahesh Yogi's writings on the nature of transcendental consciousness and the principles underlying the TM® technique.[81] However, it is unclear to what extent this theoretical framework, including any of its implications for spirituality, is a part of the practice. Sources that discuss this issue contend that the practice of the technique requires no changes in beliefs, philosophy, religion, or lifestyle,[78,80,85] implying that the theoretical framework plays no role in its practice.

Training. TM® is usually taught in a course comprising five to six hours of instruction over four days.[84] General information about the technique and its effects is presented in a 1.5-hour lecture. More specific information is given in a second 1-hour lecture. Those interested in learning the technique meet with the teacher for a 5- to 10-minute interview. The participant learns the technique on a separate day in a 1- to 1.5-hour session, following a short ceremony in which the mantra is given to the prospective practitioner. The next three sessions consist of 1.5-hour meetings held in the 3 days following, in which further aspects of the technique are explained. The teacher explains the practice of the technique in more detail, corrects practice if necessary, and explains practical arrangements (e.g., when to practice), the benefits of practice, and personal development through the technique. In addition, the technique is regularly checked by the teacher in the first months of practice to ensure correct practice, and the student is advised to continue with periodic checks thereafter.[86,87]

Clinical reports indicate that this technique can be learned easily by individuals of any age, level of education, occupation, or cultural background.[78,80,85] The technique requires systematic instruction by a qualified teacher to ensure effortless and correct practice.[78,84,86] The technique is practiced twice daily for 15 to 20 minutes, usually once in the morning (before breakfast) and once in the afternoon (before dinner).[78,85,88]

Criteria of successful meditation practice. The successful practice of the TM® technique is determined by a qualified teacher. As many details of the TM® technique are restricted to those who receive instruction, a description of the criteria used by the instructor for the assessment of the technique is not available in the scientific literature.

Relaxation Response

The "relaxation response" is a term coined by Harvard cardiologist Herbert Benson in the early 1970s to refer to the self-induced reduction in the activity of the sympathetic nervous system,[68,89] the opposite of the hyperactivity of the nervous system associated with the fight-or-flight response. Benson believed that this response was not unique to TM® and that all ancient meditation practices involved common components that together are capable of producing such a response.[68] Basing his belief on his scientific research on hypertension and TM®, he integrated these common factors into a single technique (RR) and found that it promoted a decrease in sympathetic nervous system similar to TM®.[90] Many techniques for eliciting the relaxation response have been presented in a religious context in Judaism, Christianity, or Islamic mysticism (Sufism). These techniques employ both mental and physical methods, including the repetition of a word, sound, or phrase (often in the form of a prayer); and the adoption of a passive attitude.[91] Benson emphasized that the relaxation response is not simply a state of relaxation (and should not be confused with it) or a sleep-like state, but a unique state brought about by adherence to specific instructions.[89]

Main components. The individual is instructed to assume a comfortable posture (usually sitting, but kneeling or squatting may also be used), the eyes are closed, and the muscles are relaxed, beginning at the feet and progressing upward to the face. Once the practitioner is relaxed, the eyes may be open or remain closed. Then, breathing through the nose and focusing on the breath, the practitioner inhales and exhales, silently saying the word "one" with each exhalation.[89,90,92] Like TM®, the repetition of a sound, word, or phrase is considered essential to the technique.[89] Benson recommends "one" as a neutral, one-syllable word.[93] When the practice is completed, the meditator sits quietly for several minutes with eyes closed and then with eyes open.[89]

More recent versions of the technique include a body scan (similar to that employed in MBSR, described below) in which practitioners are asked to move their attention slowly over the body focusing on relaxing different regions, and information sessions on the stress response and its effects on health.[94]

Breathing. Breathing is active. Practitioners breathe through the nose, cultivating an easy, natural rhythm.[89]

Attention and its object. Attention is focused on the breath. In addition, should distracting thoughts occur, an attempt should be made to ignore them and focus on the mantra.[92] The mantra is therefore "linked" with the breath.[68] It has been claimed that Benson's RR demands a greater degree of concentration than either TM® or CSM (described below).[64]

Spirituality and belief. Because it is believed that RR incorporates the essential components of a wide variety of meditation practices, it is conceptualized as a secular technique[89,95] and does not require adopting a specific spiritual orientation or belief system.

Training. RR is learned in approximately five minutes. Patients are typically instructed to elicit the relaxation response twice daily, for 15 to 20 minutes, but not within two hours after any meal, as the digestive processes may interfere with the subjective changes induced by the technique.[89,90,96]

Criteria of successful meditation practice. Instructions for this technique are available in books and articles and there is no explicit recommendation that an experienced practitioner teach the technique or that individualized instruction is necessary. The criteria for successful meditation practice rest with the subjective evaluation of the meditator; the results of practice judged against the reported effects of RR. Instructions for this technique include the injunction not to worry about whether one is successful in achieving a deep level of relaxation, and instead to maintain a positive attitude and let relaxation occur at its own pace.[89]

Clinically Standardized Meditation

CSM was developed by Patricia Carrington while she was conducting studies on meditation at Princeton University in the early-to-mid 1970s. Believing that TM® was not flexible enough to be suitable for all clinical purposes and that the cost of its instruction put it beyond the reach of most individuals and institutions, Carrington modified a classical Indian form of mantra meditation and produced what she called CSM.[64]

Main components. Trainees are instructed to choose a mantra from a list of 16 Sanskrit mantras, or choose their own. In choosing their own mantra, practitioners are told to select a word that has a "pleasant ringing sound" and to avoid using words that are emotionally loaded. The word should help imbue the practitioner with a sense of serenity.[64] In its original formulation, CSM used a secular ritual for transferring the mantra. CSM is practiced while sitting comfortably, with eyes open and focused on a pleasant object of some kind. The mantra is repeated aloud, slowly and rhythmically, at ever decreasing volume, until it is a whisper, at which point the mantra is no longer said aloud, but instead is only thought. The eyes are then closed as the meditator continues repeating the mantra in thought. Meditators allow the mantra to proceed at its own pace, getting faster or slower, louder or softer "as it wants."[64,97]

Breathing. Breathing is passive, proceeding at its own pace and is unconnected to the repetition of the mantra.

Attention and its object. Like TM® and RR, CSM is a passive technique that requires little concentration or discipline. In contrast to RR, CSM instructs practitioners to flow with their thoughts rather than ignore them, returning periodically to the mantra.[64]

Spirituality and belief. CSM is designed as a secular, clinical form of meditation practice, so no specific system of spirituality or belief is required.

Training. CSM is taught in two lessons: a 1-hour individual lesson and a group meeting. CSM is practiced twice daily for 20 minutes.[64] As with RR, the contemporary version of CSM differs slightly from its original form, with perhaps the most important difference being that trainees are given a manual and an audio recording of instructions rather than individual instruction.[64]

Criteria of successful meditation practice. The criteria for successful meditation practice rest with the subjective evaluation of the meditator, the results of practice judged against the reported effects of CSM. Books and audiotapes for self-instruction in CSM are readily available, and there is no explicit statement that an experienced practitioner teach the technique or that individualized instruction is necessary.

Mindfulness Meditation

Mindfulness has been described as a process of bringing a certain quality of attention to moment-by-moment experience and as a combination of the self-regulation of attention with an attitude of curiosity, openness, and acceptance toward one's experiences.[98] Mindfulness meditation, the core practice of Vipassana meditation, has been incorporated into several clinically-based meditation therapies.[76] The capacity to evoke mindfulness is developed using various meditation techniques that originated in Buddhist spiritual practices;[99] however, general descriptions of mindfulness vary from investigator to investigator and there is no consensus on the defining components or processes.[98]

Mindfulness approaches are not considered relaxation or mood management techniques,[98] and once learned, may be cultivated during many kinds of activities. Mindfulness increases the chances that any activity one is engaged in will result in an expanded perspective and understanding of oneself.[76] In a state of mindfulness, thoughts and feelings are observed on par with objects of sensory awareness, and without reacting to them in an automatic, habitual way.[98,99] Thus, mindfulness allows a person to respond to situations reflectively rather than impulsively.[98] Mindfulness meditation practices include the traditional Vipassana, and Zen meditation and the clinically-based techniques MBSR and MBCT. Of the four practices described below, the last two, MBSR and MBCT have standardized techniques (i.e., the techniques have been described systematically in manuals and are relatively invariant wherever, whenever, and by whomever they are taught).

Vipassana

Considered by some to be the form of meditation practiced by Gautama the Buddha more than 2,500 years ago,[100] Vipassana, or insight meditation, is practiced primarily in south and southeast Asia but is also a popular form of meditation in Western countries. Vipassana is the oldest of the Buddhist meditation techniques that include Zen (Soto and Rinzai schools) and Tibetan Tantra.[47,99] The Pali term “Vipassana”, though not directly translatable to English roughly means “looking into something with clarity and precision, seeing each component as distinct, and piercing all the way through so as to perceive the most fundamental reality of that thing.”[47] The goal of Vipassana is the understanding of the 3 characteristics of nature which are impermanence (anicca), sufferings (dhuka), and non-existence (anatta). Vipassana meditation helps practitioners to become more highly attuned to their emotional states.[47] Through the technique, meditators are trained to notice more and more of their flowing life experience, becoming sensitive and more receptive to their perceptions and thoughts without becoming caught up in them. Vipassana meditation teaches people how to scrutinize their perceptual processes, to watch thoughts arise, and to react with calm detachment and clarity, reducing compulsive reaction, and allowing one to act in a more deliberate way.[47]

Main components. Vipassana meditation requires the cultivation of a particular attitude or approach: (1) don't expect anything, (2) don't strain; (3) don't rush, (4) observe experience mindfully, that is, don't cling to or reject anything, (5) loosen up and relax, (6) accept all experiences that you have, (7) be gentle with yourself and accept who you are, (8) question everything, (9) view all problems as challenges, (10) avoid deliberation, and (11) focus on similarities rather than differences.[47]

Vipassana meditation is practiced in a seated position when focusing on the breath; otherwise, no posture is prescribed and the meditator may sit, stand, walk, or lie down. Traditionally, if a static position has been taken, it is not to be changed until the meditation session has ended. However, many Western teachers allow students to move, though mindfully, to avoid persistent pain caused by being in the same position for too long.[47] The time devoted to seated meditation should be no longer than one can sit without excruciating pain. The eyes should be closed.[47]

Breathing. Air is inhaled and exhaled freely through the nose. There is a natural, brief pause after inhaling and again after exhaling.[47]

Attention and its object. The focus of attention or awareness in Vipassana can be categorized into 4 groups: body, emotions and feelings, thoughts, and mental processes.[101] In focusing attention on the breath, novice Vipassana meditators attain a degree of "shallow concentration."[47] This is not the deep absorption or pure concentration of the mantra meditation techniques. Gradually, the focus of attention is shifted to the rims of the nostrils, to the feeling of the breath going in and out. When attention wanders from the breath, the meditator brings it back and anchors it there.[47,100] To help concentrate on the breath, a novice meditator may silently count breaths or count between breaths.[47] The meditator notices the feeling of inhaling and exhaling and ignores the details of the experience. The movement of the abdominal wall while inhaling and exhaling may also be used as a focus of attention.[47]

The primary technique for focusing on bodily sensations is the body scan.[102] Beginning with the top of the head, the practitioner observes the sensations as if for the first time, and then scans the scalp, the back of the head, and the face. When visualizations of the body distract the meditator, the thoughts are simply directed back to the sensations. The focus of attention is moved continuously over the body, moving down the neck, to the shoulders, arms, hands, trunk, legs and feet. Throughout the entire scan, an attitude of nonanticipation and acceptance is maintained.[102]

Mindfulness can be practiced during any activity and practitioners are encouraged to practice being mindful and fully aware during other activities such as walking, stretching, and eating.[100]

Spirituality and belief. Though often described as a profound religious practice, no particular spiritual or philosophical system is required to practice Vipassana meditation.[47]

Training. Vipassana should be practiced twice daily, morning and evening, for about 5 to 10 minutes.[100] Western interpreters of Vipassana have recommended that novice meditators should be instructed to sit motionless for no longer than 20 minutes.[47] Ideally, a meditator works up to at least two 1-hour sessions per day, and does at least one 10-day retreat per year.[102] Longer meditation sessions allow for deeper periods of meditation.[102] The length of time required to become proficient in Vipassana meditation varies by individual, some students progress rapidly, others slowly.

Criteria of successful meditation practice. As instructions for this technique are available in books and articles and there is no explicit instruction in the literature that an experienced practitioner teach the technique or that individualized instruction is necessary, it is presumed that the criteria for successful meditation practice rests with the subjective evaluation of the meditator. However, instruction may be given and, if this is the case, presumably successful practice is judged by an experienced meditator.

Zen Buddhist Meditation

Zen Buddhist meditation, or Zazen, perhaps one of the most well-known forms of meditation, is a school of Mahayana Buddhism[103] that employs meditation techniques that originated in India several thousand years ago and were introduced to Japan from China in 1191 A.D.[104] Zen Buddhist meditation is typically divided into the Rinzai and Soto schools.

Main components. The harmony of the body, the breath, and the mind is considered essential to the practice of Zen. In the traditional forms of Zen meditation, physical preparation involves eating nutritious food in modest amounts.[104]

Posture is of great importance in Zen meditation. In traditional forms, Zen meditation is performed while seated on a cushion in either the full-lotus or half-lotus position; however, many Western practitioners practice in a variety of ways from chair sitting to full lotus.[104] In the full-lotus position, the legs are crossed and the feet rest on top of the thighs. In the half-lotus position, only one foot is brought to rest on top of the thigh, the other remaining on the ground as in the regular cross-legged position.[104,105] The hands are held in one of two prescribed ways, either with the left hand placed palm up on the palm of the right hand with the tips of the thumbs touching, or with the right hand closed in a loose fist and enclosed in the left hand, the left thumb between the web of the thumb and the index finger of the right hand.[104] The spine is held straight and with the top of the head thrust upward, with the chin drawn in and the shoulders and abdomen remain relaxed. The body should be perpendicular and the ears, shoulders, nose, and navel should be in line. The tongue should touch the upper jaw and the molars should be in gentle contact with one another. The eyes should be half closed and the gaze focused on a point on the floor approximately 3 feet in front.[104,105]

Breathing. Breathing in Zen meditation is active and many breathing patterns are used. One deep breathing pattern begins with exhaling completely through an open mouth and letting the lower abdomen relax. Air is then inhaled through the nose and allowed to fill the chest and then the abdomen. This breathing pattern is repeated 4 to 10 times. The mouth is then closed, and air is inhaled and exhaled through the nose only. By the use of abdominal and diaphragmatic pressures, air is drawn in and pushed out. Both inhalation and exhalation should be smooth, with long breaths.[104] After practitioners have learned to focus on their breath by counting, counting is omitted and meditators practice "shikantaza," which means "nothing but precisely sitting."[106] Shikantaza is the most advanced form of Zen meditation.[106] With practice, the frequency of breathing becomes about three to six breaths per minute.[104]

Attention and its object. Attention is focused on counting breaths or on a koan, a specific riddle that is unsolvable by logical analysis.[106] The frequency of breathing is silently counted in one of three ways: counting the cycles of inhalation and exhalation, counting inhalations only, or counting exhalations only.[104] Though some koans have become famous in the West (e.g., what is the sound of one hand clapping?), in practice, beginners often silently repeat the sound "mu" while counting. As a student advances, there are many koans that may be worked on over a period of years.[47] This silent repetition allows the meditator to become fully absorbed in the koan. In both counting of breaths and focusing on a koan, it is essential that the concentration of the mind is on the counting or on the koan and not on respiration as such.[104] No attempt is made to focus the mind on a single idea or experience; the meditator sits, aware only of the present moment.[49]

Spirituality and belief. It is generally accepted that Buddhist metaphysical beliefs are not essential to the practice of Zen. At a spiritual level, Zen is considered a recognition of or, more accurately, the constant participation of all beings in the reality of each being.[49] Sitting should be based on the compassionate desire to save all sentient beings by means of calming the mind; however, this belief is not essential to practice. Only the wish to save all sentient beings and the strength to be disciplined in practice is necessary.[104]

Training. Depending on the purpose, Zen meditation may be practiced for a few minutes or for many hours.[103]

Criteria of successful meditation practice. Successful meditation practice is judged in terms of the internal changes that are brought about by cultivating awareness. The practice of Zen meditation should not be done with the aim of accomplishing some purpose or acquiring something.[104] Examples of incorrect aims or approaches include (1) sitting in order to tranquilize the mind, (2) sitting to be empty in one's mind, (3) attempting to solve a koan as if playing a guessing game, and (4) being motivated by a wish to escape from everyday conflicts.[104] Some Zen masters believe that it is acceptable for prospective students to be motivated by desires for good health, composure, iron nerves, etc., because in time their attachment to these less important purposes will be recognized.[104] The successful practice of Zen meditation is often described in terms of an awareness of the "true nature" of reality, of discovering the extent to which ordinary experience is constructed and manipulated by our interests, fears, and purposes. Thus, successful practice results in the realization that a dreamlike absorption in personal intentions is actually the principal content of daily mental life,[49] freeing the practitioner from circumstance and emotion.[104]

Mindfulness-Based Stress Reduction

The MBSR program emerged in 1979 as a way to integrate Buddhist mindfulness meditation into mainstream clinical medicine and psychology.[107] Originally designed by Dr. Jon Kabat-Zinn at the University of Massachusetts Medical Center, the MBSR program was a group-based program designed to treat patients with chronic pain. Since then, MBSR has also been used to reduce morbidities associated with chronic illnesses such as cancer and acquired immunodeficiency syndrome and to treat emotional and behavioral disorders.[98]

Main components. The mindfulness component of the program incorporates three different practices: a sitting meditation, a body scan, and Hatha yoga. In addition to the mindfulness meditation practice that forms the basis of the intervention, patients are taught diaphragmatic breathing, coping strategies, assertiveness, and receive educational material about stress.[96] The foundation for the practice of MBSR is the cultivation of seven attitudes:

1. nonjudgment, becoming an impartial witness to your own experience;
2. patience, allowing your experiences to unfold in their own time;

3. beginner's mind, a willingness to see everything as if for the first time;
4. trust, in your own intuition and authority and being yourself;
5. nonstriving, having no goal other than meditation itself;
6. acceptance, of things as they actually are in the present moment; and
7. not censoring one’s thoughts and allowing them to come and go.[48]

In addition to these attitudes, a strong motivation and perseverance are considered essential to developing a strong meditation practice and a high degree of mindfulness.[48] These attitudes are cultivated consciously during each meditation session.[48] As with other mindfulness practices, posture and breathing are essential.[48] The practitioner sits upright, either on a chair or cross-legged on the floor, and attempts to focus attention on a particular object, most commonly on the sensations of his or her own breath as it passes the opening of the nostrils or on the rising and falling of the abdomen or chest.[48] Whenever attention wanders from the breath, the practitioner will simply notice the distracting thought and then let it go as attention is returned to the breath. This process is repeated each time that attention wanders from the breath. The MBSR program incorporates formal meditation (i.e., seated, walking, Yoga) and informal meditation (i.e., the application of mindfulness to the activities of daily life). In informal practice, practitioners are reminded to become mindful of their breath to help induce a state of physical relaxation, emotional calm, and insight.[48]

The seated meditation is done either on the floor or on a straight-backed chair.[48] When sitting on the floor, a cushion approximately 6 inches thick should be placed beneath the buttocks. The practitioner may use the “Burmese” posture in which one heel is drawn in close to the body and the other leg is draped in front, or a kneeling posture, placing the cushion between the feet.[48] The sincerity of effort matters more than how one is sitting.[48] Posture should be erect with the head, neck, and back aligned. The shoulders should be relaxed and the hands are usually rested on the knees or on the lap with the fingers of the left hand above the fingers of the right and the tips of the thumbs just touching each other.[48]

The body scan is the first formal mindfulness technique that meditators do for a prolonged period and is practiced intensively for the first 4 weeks of the program. Body scanning involves lying on your back and moving the mind through the different regions of the body, starting with the toes of the left foot and moving slowly upwards to the top of the head. Scanning is done in silence and stillness.

The third formal meditation technique used in the MBSR program is mindful Hatha yoga. It consists of slow and gentle stretching and strengthening exercises along with mindfulness of breathing and of the sensations that arise as the practitioner assumes various postures[48]

Breathing. Breathing is passive and without any specific pattern.[48]

Attention and its object. During sitting meditation, the attention is focused on the inhalation and exhalation of the breath or on the rising and falling of the abdomen. When the mind becomes distracted with other thoughts, the attention is gently, but firmly returned to the breath or abdomen. During the body scan, attention is focused on the bodily sensations. When the mind wanders, attention is brought back to the part of the body that was the focus of awareness.[48] In contrast to other Yoga practices, mindful Hatha yoga is focused less on what the body is doing and more on maintaining moment-to-moment awareness. As in the seated meditation and body scan, the attention is focused on the breath and on the sensations that arise as the various postures are assumed.

Spirituality and belief. MBSR was designed as a secular, clinical practice and its practice does not require adopting any specific spiritual orientation or belief.

Training. The program consists of an 8-week intervention with weekly classes that last 2 to 3 hours. There is a day-long intensive meditation session between the sixth and seventh sessions.[48,96] Participants also complete 45-minute sessions at home, at least 6 days a week for 8 weeks.[48] During the 2-hour weekly sessions, participants are instructed in the informal and formal practice of mindfulness meditation. Participants must commit to a daily, 45-minute home practice of the skills taught during the weekly meetings.[48] The components of practice change as participants become more adept in sitting meditation, body scan, and Yoga. Body scan is initially practiced at least once per day for 45 minutes for about 4 weeks. It is then practiced every other day, alternating with Yoga.[48]

Criteria of successful meditation practice. The proper practice is determined by an experienced teacher. In the absence of any religious or spiritual component, the measure of success is the achievement of successful outcomes, whether subjective (reduced perceived stress, reduced anxiety, etc.) or objective (reduced blood pressure, reduction in medication usage, etc.).

Mindfulness-Based Cognitive Therapy

Developed by Zindel Segal, Mark Williams, and John Teasdale in the 1990s as a method for preventing relapse in patients with clinical depression, MBCT combines the principles of cognitive therapy with a framework of mindfulness to improve emotional well-being and mental health.[98,108] Based on the MBSR program developed by Jon Kabat-Zinn, the original aim of the MBCT program was to help individuals alter their relationship with the thoughts, feelings, and bodily sensations that contribute to depressive relapse, and to do so through changes in understanding at a deep level.[108]

Main components. Like MBSR, the MBCT program incorporates seated meditation and body scan. The practice teaches patients decentering (the ability to distance oneself from one's mental contents), how to recognize when their mood is deteriorating, and techniques to help reduce the information channels available for sustained ruminative thought-affect cycles and negative reactions to emotions and bodily sensations.[108] The core skill that the MBCT program aims to teach is the ability, at times of potential relapse, to recognize and disengage from mind states characterized by self-perpetuating patterns of ruminative, negative thought.

Breathing. Breathing is passive and without any specific pattern.[108]

Attention and its object. During seated meditation, the attention is focused on the inhalation and exhalation of the breath or on the rising and falling of the abdomen. When the mind becomes distracted, the attention is gently, but firmly, returned to the breath or abdomen. During the body scan, attention is focused on the bodily. When the mind wanders, attention is brought back to the part of the body that was the focus of attention.

Spirituality and belief. Like MBSR, MBCT was developed as a secular, clinical intervention and does not require adopting any specific spiritual orientation or belief system.

Training. The program consists of an 8-week program, with one 2-hour session per week. Classes contain approximately 12 students. The program is divided into two main components: in sessions one to four, participants are taught to become aware of the constant shifting of the mind and how to bring the mind to a single focus using a body scan technique and breathing. Participants also learn how the wandering mind can give rise to negative thoughts and feelings. In sessions five to eight, participants learn how to handle mood shifts, either immediately or at a future time.

Like the MBSR program, participants must continue the sessions at home for 6 or 7 days and complete various homework exercises that teach and reinforce mindfulness skills and help participants to reflect on their mindfulness practice.[108]

Criteria of successful meditation practice. The presence of an instructor who is adept in the practice of mindfulness is crucial to the success of the program. It is generally believed that if instructors are not mindful as they teach, the extent to which class members can learn mindfulness will be limited.[108] The proper technique is determined by an experienced practitioner. The measure of success is the achievement of successful prevention of relapse based on clinical criteria.

Yoga

The philosophy and practice of Yoga date back to ancient times, originating perhaps as early as 5,000 to 8,000 years ago.[1,109,110] It has been argued that the rules or precepts set down in the first systematic work on Yoga, Patanjali's Yoga Sutras, do not set forth a philosophy, but are practical instructions for attaining certain psychological states.[111,112] It is important to acknowledge the diversity of techniques subsumed under the term "Yoga." Over many millenia, different yogic meditative techniques had been developed and used to restore and maintain health, and to elevate self-awareness and to also transcend ordinary states of consciousness, and ultimately to attain states of enlightenment.[110]

Yogic meditative techniques have been transmitted through Kundalini yoga, Sahaja yoga, Hatha yoga and other yogic lineages.[113] Though there are numerous styles of Yoga;[114] the styles vary according to the emphasis and combination of four primary components: asanas, pranayamas, mantras, and the various meditation techniques.[115] In Kundalini yoga, there are thousands of different postures, some dynamic and some static, and also thousands of different meditation techniques, many of which are disorder specific.[116,117] Kundalini yoga meditation techniques are usually practiced while maintaining a straight spine, and employ a large number of specific, and highly structured breathing patterns, various eye and hand postures, and a wide variety of mantras. All of these techniques supposedly have different effects and benefits in their respective combinations.

Within Hatha yoga, many "schools" have developed, each differing slightly in its emphasis on the use of breathing and postures: in Bikram Yoga, practitioners perform the same sequence of 26 asanas in each session; in Vini Yoga, emphasis on the breath makes for a slower-paced practice. Iyengar Yoga is distinguished from other styles by its emphasis on precise structural alignment, the use of props, and sequencing of poses.[118,119] There are also two Tibetan yogic practices, Tsa Lung and Trul Khor, that incorporate controlled breathing, visualization, mindfulness techniques, and postures.[120] In Yoga, it is also believed that the practice of meditation techniques can be enhanced by the proper cleansing and conditioning of the body through the asanas and breathing exercises, or pranayama techniques[121] (though pranayama places particular emphasis on techniques of breathing, some pranayama also employ physical movements).[122]

In addition to the schools of Yoga described above, TM® and the secular meditation techniques RR and CSM are derived from classical yogic techniques.[123] It is important to note that the techniques in any given school or type of Yoga represent distinct interventions, in much the same way that psychodynamic, cognitive-behavioral, and interpersonal therapies each involve different approaches to psychotherapy.[124]

The purpose of asanas, pranayams, and pratyahar (emancipation of the mind from the domination of the senses) is to help rid the practitioner of the distractions of body, breath, and sensory activity and to prepare the body and mind for meditation and spiritual development.[114] The use of mantras is said to help cleanse and restructure the subconscious mind, and to help prepare the conscious mind to experience the various states of superconsciousness. The more advanced Yoga practices lie in dharana (concentration), dhyana (yogic meditation) and samadhi (absorption). Concentration involves attention to a single object or place, external or internal (e.g., the space between the eyebrows, the tip of the nose, the breath, a mantra [chanted loudly, softly, or silently] or attention to all of these elements simultaneously). When the mind flows toward the object of concentration uninterruptedly and effortlessly, it is meditation. When it happens for a prolonged period of time it leads to samadhi, the comprehension of the true nature of reality that ultimately leads to enlightenment and emancipates the practitioner from the bonds of time and space.[123,125]

Main components. Classical Yoga is an all-encompassing lifestyle incorporating moral and ethical observances (yamas and niyamas), physical postures (asanas), breathing techniques (pranayams), and four increasingly more demanding levels of meditation (pratyahar, dharana, dhyana, and samadhi).[126,127] Due to the incredible diversity of techniques in yogic meditation practice, it is impossible to describe them in adequate detail here. Instead, we have attempted to provide the reader with a very general description of the main components of many yogic meditation techniques. The reader is directed to the reference list for more detailed information on specific Yoga styles or techniques.[110,116,117,119,128,129]

The most common translation of “asana” is “posture” or “pose” and it refers to both specific postures for gaining greater strength and flexibility and those used specifically to help achieve proper concentration for meditation. Asanas are practiced either standing, sitting, supine, or prone.[130] The postures for strength and flexibility take each joint in the body through its full range of motion, stretching, strengthening, and balancing each body part.[114] Depending on the particular yogic technique one follows and the individual level of practice, each asana is held anywhere from a few breath cycles (as long as 2 minutes) to as long as 10 minutes or, in the case of some advanced practices, even 2.5 hours.

In most schools, during each posture attention is directed to the breath—to the deep, in-out, rhythmic sensation—and awareness is brought to the area of the body that is being stretched or strengthened.[130] Though poses may be held for a few seconds to a few minutes, the body can also be in constant dynamic motion. Muscles relax and loosen, changing the shape of the pose, and the in and out breath moves in rhythm with the body. The practitioner simply observes the physical or psychical sensations and emotions arising while suspending judgment. The asanas are interspersed with brief moments of relaxation during which the practitioner attempts to redirect or maintain an inward focus.[130]

In postures used specifically for meditation, for example in Kundalini yoga, the spine is kept straight and the practitioner can be seated in a chair with the feet flat on the floor or seated in a cross-legged posture, and specific directions are given regarding the positioning of the arms, hands, and eyes, (e.g., the palms of the hands can be pressed together with the fingers together pointing up at a 60-degree angle, and the sides of the thumbs rest on the sternum in what is called “prayer pose,”[129] and the eyes are closed as if looking at a central point on the horizon, the "third eye," or the notch region between the eyes). A mantra (again technique specific) may also be chanted, and/or a simple or complex breathing pattern may be employed.[129] Alternately, the eyes might be kept open and focused on the tip of the nose or closed and focused on the tip of the chin or top of the head, again in conjunction with any number of a wide variety of breathing patterns, and/or mantras.[129] In Sahaja yoga, practitioners sit in a relaxed posture with hands in front, palms upward. Attention is directed to a picture placed in front with a candle lit before it. Gradually when thoughts recede, meditators close their eyes and direct their attention to the "sahasrara chakra" or top of the head. The individual sits in meditation for about 10 to 15 minutes.[131] The amount to which the eyes are open or closed also varies; eyes may be fully open, fully closed, or half-closed.

Breathing. A central focus for most yogic meditation techniques is the breathing pattern.[119] Pranayams, or breathing exercises, involve the conscious regulation of rhythmic breathing patterns, where some or all of the inspiration, breath retention, expiration, and breath out phases are regulated according to specific ratios or times. The inspiration and expiration phases can also be regulated by breaking each breath of the inspiration and expiration into 4 parts, 8 parts, or 16 parts or only the inspiration may be broken while the expiration remains unbroken.[132] In addition, a breath pattern may be employed selectively through either the left or right nostril (or a sequential combination of both), or specific combinations of the nose and mouth. A wide variety of broken breath patterns have been discovered that have varying effects. Some techniques may also require holding attention on the imagined flow of energy along the spinal column collaterally with the breathing rhythm, on the sensation of inhaled air touching and passing through the nasal passage, on other parts of the body, or on a mantra.[129,133]

In Hatha yoga, various patterns of respiration are closely coordinated with the body in either a static posture or with movement.[134] There are many pranayama techniques described in Hatha yoga texts; however, the practice of pranayama in this tradition has four primary objectives: (1) a stepwise reduction in breathing frequency, (2) attainment of a 1:2 ratio for the duration of inspiration and expiration respectively, (3) holding the breath for a period at the end of inspiration that lasts twice the length of expiration, i.e., a 1:4 ratio between inhalation and retention, and (4) mental concentration on breathing.[121,135] The four objectives are united in the achievement of a single purpose, namely, the slowing down of respiration to achieve an immediate intensification of consciousness through the elimination of external stimuli.[136]

Practices such as Sudarshan Kriya Yoga involve rhythmic breathing at different rates following ujjayi pranayama (long and deep breaths with constriction at the base of throat) and bhastrika (fast and forceful breaths through the nose along with arm movements).[137,138] Other practices, such as Iyengar Yoga, instruct the practitioner to breath through the nostrils only while performing the asanas.[139] Some varieties of pranayama require the practitioner to inhale and exhale through one nostril selectively, a practice called unilateral forced nostril breathing.[119,140] These breathing exercises are often practiced in combination with different postural locks (bandhas). Bandhas are restrictive positions or muscle maneuvres that exercise certain parts of the body. The most common of these are the abdominal lift (uddiyana bandha), the root lock (mula bandha), and the chin lock (jalandhara bandha).[123]

In Kundalini yoga, there are hundreds of different breathing patterns, each having unique and specific benefits and effects. In "Sodarshan Chakra Kriya," considered one of the most powerful pranayama meditation techniques in Kundalini yoga, a unilateral forced nostril breathing pattern is employed selectively with inspiration through the left nostril, with breath retention, and with selective expiration through the right nostril. During the breath retention phase the abdomen is pumped in and out 48 times and a three-part mantra is mentally repeated 16 times in phase with the abdominal pumping (one repetition of the three-part mantra with three pumps), and the eyes are open and focused on the tip of the nose. As the technique is mastered, the rate of respiration is eventually reduced to less than one breath per minute and practiced for a maximum of 2 hours and 31 minutes.[129]

Attention and its object. Inherent in the practice of Yoga is an effortful progression toward increased concentration, or, more precisely, toward entering a state in which the mind is highly stable and still, consciously and purposely focused, and ordinary thoughts are suspended, and the meditator is more aware of the present moment (samadhi*).*[141,142] This state has been described as the complete merging of the subjective consciousness and the object of focus.[130] Hatha yoga has been defined as gentle stretching and strengthening exercises with constant awareness of breathing and of the sensations that arise as the meditator assumes various postures.[76,128] By manipulating the body and making minute, detailed adjustments to perfect each posture, a person develops "one-pointed" concentration and ceases to become distracted by extraneous thoughts.[130]

One Hatha yoga technique, Shavasana, or corpse pose, involves lying on the back, with legs resting on the floor slightly apart, arms at the sides, palms facing up, and eyes closed. This seemingly simple pose is actually one of the most demanding to perfect because of the practitioner's need to achieve absolute stillness and total concentration as well as control over the breath.[119] If drowsiness occurs, practitioners are told to increase the depth of their breathing. If the mind is restless, attention to the breathing cycle or other bodily sensations is encouraged. The goal is to rest in a state of relaxation, yet be aware of raw, sensory information and to let go of any reactions or judgments.[121]

In Kundalini yoga, one complex meditation technique called "Gan Puttee Kriya", with multiple aspects of focus, is said to help eliminate negative thoughts, "psychic scarring," and acute stress.[116] The practitioner sits with a straight spine, either on the floor or in a chair. The backs of the hands are resting on the knees with the palms facing upward. The eyes are open only one-tenth of the way, but looking straight ahead into the darkness, not the light below. The practitioner chants consciously from the heart center in a natural, relaxed manner at a rate of one sound per second. The practitioner begins by chanting "SA" (the A sounding like "ah"), and touching the thumbtips and index fingertips together quickly and simultaneously then chanting "TA" and touching the thumbtips to the middle fingertips, then chanting "NA" and touching the thumbtips to the ring fingertips, then chanting "MA" and touching the thumbtips to the little fingertips, then chanting "RA" and touching the thumbtips and index fingertips, then chanting "MA" and touching the thumbtips to the middle fingertips, then chanting "DA" and touching the thumbtips to the ring fingertips, then chanting "SA" and touching the thumbtips to the little fingertips, then chanting "SA" and touching the thumbtips and index fingertips, then chanting "SAY" (like the word "say") and touching the thumbtips to the middle fingertips, then chanting "SO" and touching the thumbtips to the ring fingertips, then chanting "HUNG" and touching the thumbtips to the little fingertips. The thumbtips and fingers touch with about 2 to 3 pounds of pressure with each connection which supposedly helps to consolidate a circuit created by each thumb-finger link. The techniques can be practiced for 11 minutes (or less) to a maximum of 31 minutes. When finished, the practitioner remains in the sitting posture and inhales and holds the breath for 20 to 30 seconds while shaking and moving every part of the body vigorously, with the hands and fingers moving very loosely, then exhaling and repeating this two additional times, immediately followed by opening the eyes and focusing them on the tip of the nose and breathing slowly through the nose for one minute.

Spirituality and belief. Yoga is a science and philosophy of the human mind and body; it is a way of life, moral as well as practical.[143] Yoga predates all formal religions,[1,129] and, perhaps for this reason, the practice of Yoga does not presuppose an individual's commitment to a particular philosophical or religious system.[144,145]

Training. The ethical principles of Yoga describe the essential attitudes and values that are needed to undertake the safe practice of Yoga. The physical practice of Yoga focuses on the development of the strength, flexibility, and endurance of the body, strengthening of the respiratory and nervous systems, development of the glandular system, and increasing the ability to concentrate. In its complete form, Yoga combines rigorous physical training with meditation practices, breathing, and sound/mantra techniques that lead to a mastery of the body, mind, and consciousness. Both ancient commentaries on Yoga and more modern books of instruction stress the importance of learning under the guidance of an experienced teacher, Guru or Master.[110,121,139] However, some Yoga techniques, especially asanas, pranayams, and meditation techniques, have been described and illustrated in books and videos produced for the purpose of self-study.[139] In terms of specific training requirements, it is recommended that Yoga exercises be practiced daily, preferably in the morning, and on an empty stomach.[139] Exercises can last from 15 minutes to several hours and it can take several years of consistent practice before a practitioner is able to practice properly the more demanding asanas and meditation techniques.[121]

Criteria of successful meditation practice. The ideal instruction in and assessment of Yoga techniques comes from a Guru or Master. Nevertheless, as books and video instruction are available, it can be assumed that the practitioner is able, to varying degrees, to assess the correctness of at least some asanas, pranayams, and a wide variety of meditation techniques.

Yoga is ultimately a tradition of spiritual self-discipline and practice for the pursuit of enlightenment.[136] Like Vipassana and Zen Buddhism, the success of meditation practice is judged on the basis of the practitioner achieving this state of enlightenment or other intermediate psychological or spiritual states. For example, the central experience achieved through Sahaja yoga meditation is a state called "thoughtless awareness" or "mental silence" in which the meditator is alert and aware but is free of any unnecessary mental activity.[12] The state of thoughtless awareness is usually accompanied by emotionally positive experiences of bliss. In general, the outcome of the meditative process is associated with a sense of relaxation and positive mood and a feeling of benevolence toward oneself and others.[146]

As Yoga also involves exercises to strengthen the body and voluntarily control different aspects of breathing, success in these techniques can be evaluated against the standards for practice (e.g., achieving a 1:4:2 ratio in inhalation, retention, and exhalation), or developing the ability to reduce the rate of respiration to one breath per minute for 1 or 2 hours. Successful practice can also be determined by a subjective and objective evaluation of the achievement of some of the reported health benefits.

Tai Chi

Tai Chi (also romanized as Tai Chi Ch'uan, T'ai Chi Ch'uan, Taijiquan, Taiji, or T'ai Chi) has a history stretching back to the 13th century A.D. to the Sung dynasty.[147] There are five main schools, or styles, of Tai Chi, each named for the style's founding family: Yang, Chen, Sun, Wu (Jian Qian), and Wu (He Qin).[148] Each style has a characteristic technique that differs from other styles in the postures or forms included, the order in which the forms appear, the pace at which movements are executed, and the level of difficulty of the technique.[148] Though differing in focus on posture and the position of the center of gravity, all styles emphasize relaxation, mental concentration, and movement coordination.[147] Tai Chi practice usually involves the need to memorize the names associated with each posture and the sequence of postures.[148]

Main components. The practice of Tai Chi encompasses exercises that promote posture, flexibility, relaxation, well-being, and mental concentration.[148,149] It is characterized by extreme slowness of movement, absolute continuity without break or pause, and a total focusing of awareness on the moment.[150] Unlike most exercises that are characterized by muscular force and exertion, the movements of Tai Chi are slow, gentle and light. The active concentration of the mind is instrumental in guiding the flow of the body's movements.[151] Thus, Tai Chi is not only a physical exercise, but also involves training the mind, and this has prompted some to consider the practice "moving meditation."[148-150] Although Tai Chi follows the principles of other types of martial arts that focus on self-defense, its primary objective is to promote health and peace of mind. In contrast to other martial arts, Tai Chi is performed slowly, with deep and consistent breathing.[151] The movements should be performed in a quiet place that will help the practitioner to achieve a relaxed state. The muscles and joints are relaxed and the body is able to move easily from one position to another. The spine is in a natural erect position, and the head, torso, arms, and legs should be able to move freely and gently. The upper body is straight, never bending forward or backward, or leaning left or right.[152]

Breathing. Several different breathing techniques are employed in Tai Chi; however, the principal breathing technique, called "natural breathing," is the foundation for all other breathing techniques. In natural breathing, the practitioner takes a slow, deep (but not strained) breath, inhaling and exhaling through the nose. The mouth is closed, but the teeth are not clenched. The tip of the tongue is held lightly against the roof of the mouth. As the air is taken in, the lower abdomen expands. Once the lungs are adequately filled with air, the person exhales and the lower abdomen contracts. The breath is never held. The eyes should be lightly closed.[152]

The movements of Tai Chi are coordinated with the breath, and the pattern of breathing follows the succession of opposing movements of the arms: inhalation takes place when the arms are extended outward or upward, exhalation occurs as arms are contracted or brought downward. Breathing eventually becomes an unconscious part of the exercise; however, its importance in the practice never diminishes.[150]

Attention and its object. Throughout the practice, the mind remains alert but tranquil, directing the smooth series of movements and focusing on one's internal energy. This active concentration is integral to the practice.[149,151] It has been argued that if Tai Chi movements are performed without concentration, Tai Chi is no different from other forms of exercise. The variety and distinctiveness of the movements ensure that one concentrates on the execution of the movements.[151]

Spirituality and belief. Tai Chi derives its philosophical orientation from the opposing elements of *yang* (activity) and *yin* (inactivity) and from *qi* (breath energy).[147] In accordance with the symbols of yin and yang, Tai Chi movements are circular. The movements are designed to balance the qi, or vital energy, in the meridians of the body, and strengthen the qi, thus preventing illness.[153] Like Yoga, the practice of Tai Chi does not require adopting a specific spiritual or belief system and has been used clinically as a therapeutic intervention.

Training. The exercise routines of the different forms of Tai Chi vary in the number of postures and in the time required to complete the routine,[147] with some Tai Chi programs being modified to suit the abilities of practitioners with declining physical and mental function.[148] Classical Yang Tai Chi includes 108 postures with some repeated sequences. Each training session includes a 20-minute warm-up, 24 minutes of Tai Chi practice, and a 10-minute cooldown. The warm-up consists of 10 movements with 10 to 20 repetitions. However, the exercise intensity depends on training style, posture, and duration.[154]

When practiced solely as an exercise form, sessions should occur twice a day and last about 15 minutes, 4 or more days per week.[147] Practitioners are not required to continue training permanently with a Tai Chi teacher, and can continue practice as a form of self-therapy.[152] When used as a system of self-defense, Tai Chi must be practiced with a Master and long enough to develop a deep understanding and "body memory" of the movements.[155] However, as a healing practice, years of study are not required and the typical practitioner may be able to learn the fundamental movements within a week.[155]

Criteria of successful meditation practice. The overall aim is not to "master" the movements, but to appreciate a developing sense of inner and outer harmony as the movements become more fluid, yet controlled, and the mind more alert, yet peaceful.[149] To learn and practice Tai Chi successfully, practitioners must adopt and practice specific traditional principles of posture and movement such as holding the head in vertical alignment, relaxing the chest and straightening the back, using mental focus instead of physical force, and seeking calmness of mind in movement.[148]

Qi Gong

Qi Gong is classified as one of the practices known as "energy healing," a category that includes Reiki, therapeutic touch,[156] and the Korean practice of Chundosunbup. Dating back more than 3,000 years to the Shang Dynasty (1600 to 1100 B.C.), Qi Gong is believed to be the basis for traditional Chinese medicine.[157] Qi Gong is intimately connected with the practice of Tai Chi in that both exercises utilize proper body positioning, efficient movement, and deep breathing. A quiet focused mind is also essential to both. The main difference between Qi Gong and Tai Chi is that Tai Chi is a martial art. Usually practiced slowly, Tai Chi movements can be sped up to provide a form of self-defense, whereas this is not the case with the forms of Qi Gong. As a result, the visualization that accompanies a particular form is different: for a movement in Tai Chi that might involve visualizing the external consequences of a motion (e.g., disabling one's adversary), the same movement in Qi Gong would involve the visualization of an internal consequence of qi flow (e.g., qi flowing down your arm, healing your arthritis).[155] There are two forms of Qi Gong practice: internal (nei qi), consisting of individual practice, and external (wai qi), whereby a Qi Gong practitioner “emits” qi for the purpose of healing another person.[156,158] External Qi Gong is not a meditative practice according to the working definition developed for this report. Specifically, is not a self-applied practice, and there is a relationship of dependency between the practitioner and the person being treated. For this reason, this review is restricted to studies using internal Qi Gong.

Qi Gong is said to have several thousand forms. There are five main schools or styles of Qi Gong, each emphasizing a different purpose for practice[157] and incorporating different exercises: Taoist, Buddhist, Confucian, Medical, and Martial.[155] It is believed that every Qi Gong style has its own special training methods, objectives, and compatibility with an individual's constitution and physique.[159] Despite this variation in technique, the main function of Qi Gong is to regulate the mind.[160]

Main components. Qi Gong, literally “breathless exercise,” consists primarily of meditation, physical movements, and breathing exercises. The main components of Qi Gong vary, but most emphasize correct posture and body alignment, regulation of respiration, posture, and mind, as well as self-massage and movement of the limbs.[155,160] In general, Qi Gong consists of two aspects: (1) dynamic or active Qi Gong, which involves visible movement of the body, typically through a set of slowly enacted exercises, usually performed in a relaxed stationary position;[155] and (2) meditative or passive Qi Gong, which comprises still positions with inner movement of the diaphragm.[156] In some concentration practices, the eyes are closed and the tip of the tongue touches the front of the upper palate.[160] Essential to both aspects of practice are alert concentration, precise control of abdominal breathing, and a mental concentration on qi flow.[156]

Qi Gong, as a practice of self-regulation, includes regulation of the body (e.g., relaxation and posture), breath (to breathe deeply and slowly), and mind (thinking and emotion). Methods for the regulation of the mind vary. Some forms of Qi Gong stress thinking, e.g., focusing on a specific object or visualization. Other forms emphasize regulation of the emotions (e.g., a peaceful and calm mood), but let thinking go or remain "no-thought." Accordingly, Qi Gong techniques may be classified as one of two forms: concentrative Qi Gong and nonconcentrative Qi Gong.[161] Self-practice of Qi Gong consists of three major forms: guided movement (dynamic form), pile standing, and static meditation.[162] Whether with motion or without, the aim of Qi Gong is to remove all thoughts and focus on a region of the body known as “dantian” (the elixir field). As the body relaxes, the mind concentrates on the elixir field and all other thoughts are erased, while respiration becomes deeper and gradually decreases in frequency. When the respiration rate is decreased to four or five times per minute, the subject falls into the so-called Qi Gong state.[161] It is recommended that a student practice only one type of Qi Gong before learning another as not all techniques are congruent.[155]

Breathing. Qi Gong breathing is characterized by a concentration of attention on dantian in concert with inhalation, exhalation, and holding of breath in order to stimulate qi and blood, and to strengthen the body.[159] There are many ways to regulate the breath in Qi Gong including natural breathing, chest breathing, abdominal and reverse-abdominal breathing, holding the breath, and one-sided nostril and alternating nostril techniques.[160]

Attention and its object. A main tenet of Qi Gong is that intention can direct the qi within the body; the mind leads the qi, and qi leads the blood.[158] To exert this control over qi, the practitioner must calm the mind and clear it of thoughts. A person's success Qi Gong is directly related to the ability to concentrate in this way. This is done by focusing the mind and body on correct breathing, and the visualization of qi as a substance moving through the body.[160]

Spirituality and belief. Qi Gong posits the existence of a subtle energy (qi) that circulates throughout the entire human body. Pain and disease are considered to be the result of qi blockage or imbalance; strengthening and balancing qi flow can improve health and ward off disease.[159,162] Taoism, an ancient spiritual tradition in East Asia, is a philosophical perspective underlying the practice of Qi Gong. The Tao is the indefinable ultimate reality—the process involving every aspect in nature and in the entire universe. Similar to the worldviews of Buddhism and Hinduism, Taoism emphasizes harmony with nature. The universe is viewed in a dynamically continuous flow and constant change.[163]

Basic concepts considered essential to the understanding of Qi Gong include qi, vital energy, and gong, the skill, control, training, cultivation and practice of adjusting physical, mental and spiritual phenomena. Yin and yang, two other crucial concepts, are complementary opposites: yin signifies decrease, stillness, darkness, the six solid organs (lungs, spleen, heart, kidneys, pericardium, and liver), and bodily substances; yang signifies increase, activity, lightness, the upper and exterior parts of the body, the six hollow organs (large intestine, stomach, small intestine, urinary bladder, gallbladder, san jiao [not an organ, but the sum of the functions of transformation and interpenetration of various densities and qualities of substance within the organism]), and bodily functions.[160]

Training. Because of the possibility of Qi Gong-induced disorders from improper practice, or from the combination of incongruent forms, proper coaching is considered mandatory for safe Qi Gong practice.[159] Qi Gong should be practiced twice daily for 20 to 30 minutes[160,164] with no single session exceeding 3 hours.[159]

Criteria of successful meditation practice. Correctness of technique is judged by a Qi Gong Master. No statement of the criteria for evaluating successful outcomes was available in the literature.

Characteristics of Meditation Practices

Main Components

What are the main components of the various meditation practices? Which components are universal and which ones are supplemental?.

The variety of meditation practices is an indication of the diversity of the combination of main components and the way in which a given component may be emphasized in a practice. Given the multitude of practices and the many variations or techniques within these practices, it is impossible to select components that might be considered universal or supplemental across practices. Some practices prescribe specific postures (e.g., Zen Buddhist meditation, Tai Chi, Yoga) while others are less concerned with the exact position of the body (e.g., TM®, RR, CSM). Some practices (e.g., Vipassana, Zen Buddhist meditation, Yoga, Tai Chi, and Qi Gong) incorporate moving meditation, while others are strictly seated meditations (e.g., TM®, RR, and CSM). Some clinically-based practices (e.g., MBSR, MBCT), though guided by the underlying practice of mindfulness, combine several techniques. In this, however, they are not substantially different from older multifaceted meditation practices such as Yoga.

More detailed summaries addressing the main components used to describe individual practices are described below and summarized in Table 4. However, it is worth noting here some general conclusions that can be drawn from them. Though some statement about the use of breathing is universal across the practices, this seems more indicative of the ubiquitousness of breathing in humans rather than a universal feature of meditation practices per se. The control of attention is putatively universal; however, as noted below, there are at least two aspects of attention that might be employed and a wide variety of techniques for anchoring the attention, no one of which is universal. In terms of the spiritual or belief component of meditation, no meditation practice required the adoption of a specific religious framework. However, if Taoist metaphysical assumptions of Qi Gong are crucial to correctly understanding, visualizing, and guiding qi flow, then at least this practice would seem to require the adoption of a particular belief system. Nevertheless, this aspect of all meditation practices is poorly described, and it is unclear in what way and to what extent spirituality and belief play a role in the successful practice of meditation at all levels. The amount of variation in the described frequency and duration of practice make it difficult to draw generalizations about the training requirements for meditation techniques. Lastly, the criteria for successful meditation, for both the correct practice of the technique and the achievement of successful outcomes, have not been described well in the literature.

Breathing

How is breathing incorporated in these practices? Are there specific breathing patterns that are integral elements of meditation? Is breathing passive or directed?

The use of the breath is ubiquitous in all practices; however, the importance and attention given to it vary from practice to practice. Each meditation practice and technique has a breathing pattern or element that can be considered integral to that technique, whether the breath is actively controlled in terms of its timing and depth (e.g., Zen Buddhist meditation, Yoga, Tai Chi), or passive and "natural" (e.g., TM®, RR, CSM, Vipassana, MBCT). The practice of Yoga, which covers thousands of techniques, uses both active and passive breathing. Though the direction for active breathing may be relatively uniform across the techniques in a given practice (e.g., Zen Buddhist meditation), other practices use a wide array of breathing techniques that change according to the outcome desired (e.g., Kundalini yoga). For those practices that utilize passive breathing, there is no consistent pattern or rhythm as "breathing naturally" will vary from practitioner to practitioner.

Attention and Its Object

For each type of meditation practice, where is the attention directed during meditation (e.g., mantra, breath, image, nothing)?

The purposeful focusing of attention is considered crucial in all meditation practices. However, like breathing, the techniques for anchoring attention vary and there is no single method shared by all practices. For those practices that use a mantra (e.g., TM®, RR, CSM), in some the mantra may be repeated silently, and in some aloud. The factors surrounding the choice of the mantra vary and the nature of the mantra chosen will influence the number of associations brought forth by the word and the vibrations caused by the vocalization of the mantra. Some mantras will have no meaning to Western practitioners unfamiliar with Sanskrit (e.g., TM®, CSM, Yoga), while others will (e.g., RR).

Other forms of meditation practice focus attention on bodily sensations (e.g., Vipassana, MBSR, MBCT) or a body part (e.g., Tai Chi) to the exclusion of other thoughts. The so-called mindfulness techniques focus on the breath and cultivate an objective openness to whatever comes into awareness.[72] Though this may be interpreted as not focusing attention, or, as it is sometimes paradoxically phrased, as focusing on nothing, the attention is controlled and directed with the aim of achieving a distance from one's emotional and cognitive responses to the objects in the field of attention. The difference between mindfulness meditation and other practices lies in the acceptance of these other thoughts into the field of awareness.

Though the distinction between concentrative and mindfulness meditation has prima facie validity, the reality is somewhat more complicated because some practices, such as Zen and Vipassana, have phases where concentration is used, and for which certain techniques such as counting or concentrating on a mantra are employed, while at other stages broad spaced mindful attention is encouraged.

Spirituality and Belief

To what extent is spirituality a part of meditation? To what extent is belief a part of meditation?

The one common feature of all meditation practices examined in this review is the apparent ability to practice meditation without adopting a specific system of spiritual or religious belief. However, the extent to which spirituality and belief are part of any given meditation practice is poorly described. Furthermore, if the Taoist metaphysical assumptions of Qi Gong are crucial to successfully understand, visualize, and guide qi, then at least this practice requires adoping a specific belief system.

The extent to which spirituality or belief play a role in any meditation practice appears to depend in large part on the individual practitioner. Though the traditional practices were developed within specific spiritual or religious contexts (Vipassana, Zen Buddhist meditation, Yoga, Tai Chi, Qi Gong), and therefore have spiritual or religious aspects, this does not mean that a practitioner must adopt the belief systems upon which they were based. In addition, some practices developed for purposes other than spiritual enlightenment; for example, Tai Chi and Qi Gong were developed within a system martial exercise and Traditional Chinese Medicine, respectively. Though Yoga, too, has spiritual and religious components, it is often considered more properly a system of metaphysics and psychology, especially when the ethical instructions are ignored. In summary, it appears that all meditation practices can be performed, to some degree, without adopting a specific system of spirituality or belief.

Training

What are the training requirements for the various meditation practices (e.g., the range of training periods, frequency of training, individual and group approaches)?

Training refers to the specific periods of practice, the frequency and duration of practice, and how long a practitioner is expected to train before becoming proficient in a given technique. The training for meditation varies with periods of practice, ranging from 5 minutes (RR, Vipassana) to several hours (Yoga). The frequency of practice ranges from daily (MBSR, MBCT, Tai Chi, Vipassana, Yoga) to twice daily (TM®, RR, CSM, Qi Gong). Zen meditation does not specify a frequency of practice. Few practices give a required duration of practice; however, some (Yoga, Zen Buddhist meditation) give an indication of the time required to master a given technique.

Criteria of Successful Meditation Practice

How is the success of the meditation practice determined (i.e., was it practiced properly)? What criteria are used to determine successful meditation practice?

The criteria of successful meditation practice is understood both in terms of the successful practice of a specific technique (i.e., the technique is practiced properly) and in terms of achieving the aim of the meditation practice (e.g., leading to reduced stress, calmness of mind, or spiritual enlightenment).

The successful practice of a specific technique is sometimes judged by an experienced or master practitioner (TM®, MBSR, Yoga, Tai Chi, Qi Gong), and in some cases it can be judged by the individual (RR, CSM). However, the proliferation of self-instruction books and videos for some of the practices that also recommend an experienced teacher implies that individuals may judge, to some degree, the success of a practice.

Table 4. Characteristics of included meditation practices

Meditation practice	Main components	Breathing	Attention	Spirituality/belief	Training	Criteria for success
Mantra meditation						
TM®	Sitting (no prescribed posture) Personalized Sanskrit mantra Eyes closed	Passive, unconnected to repetition of mantra No description of breathing	Attention directed to prescribed mantra Mantra repeated silently	No specific spiritual or religious beliefs required	Taught in 4 consecutive days (preceded by two 1-hour lectures and a 5-10 minute interview) in a 1-hour training session and three 1.5 hour group sessions. Individual instruction Practiced twice daily, 15-20 min/session Instruction by qualified TM® teacher	Proper technique as judged by experienced TM® teacher; no specific criteria
Relaxation Response	Comfortable posture (sitting, kneeling, squatting) Eyes open or closed Can also include body scan and information sessions	Passive, but mantra is “linked” to exhalation Nasal	Attention focused on the breath Mantra repeated silently Thoughts are ignored	No specific spiritual or religious beliefs required	Taught in 5-min training session Individual instruction Practiced twice daily, 15-20 min/session and not before 2hrs after a meal	Proper technique according to subjective evaluation and measured against reported effects of RR
Clinically Standardized Meditation	Comfortable seated posture Sanskrit mantra or individually chosen mantra Eyes open initially and focused on pleasant object, then closed for repetition of mantra	Passive, unconnected to repetition of mantra	Attention directed to individually chosen mantra (1 of 16) Mantra repeated aloud and then at decreasing volume until it is repeated silently Thoughts recognized, but not focused on	No specific spiritual or religious beliefs required	Taught in 2 1-hr lessons Individual instruction or training manual and audio tapes Practiced twice daily for 20 min/session	Proper technique according to subjective evaluation and measured against reports of effects of CSM

Table 4. Characteristics of included meditation practices (continued)

Meditation practice	Main components	Breathing	Attention	Spirituality/belief	Training	Criteria for success
Mindfulness meditation						
Vipassana	Cultivation of a "mindful" attitude Seated posture	Passive Nasal	Attention is focused on the breath (first on the inhalation and exhalation, then shifted to rims of the nostrils) or on bodily sensations	No specific spiritual or religious beliefs required	No specific training period given Session should last no longer than one can comfortably sit Novice meditators no longer than 20 min	Proper technique determined by experienced meditator or by self-evaluation
Zen	Specific seated postures (lotus or half-lotus), positioning of hands, mouth and tongue Eyes half closed and focused on point on floor	Active Inhale through nose, exhale through mouth and nasal only Many breathing patterns	Attention focused on counting of breath, on a koan or "just sitting." Breath counted by 1 of 3 methods No attempt to focus on single idea or experience	No specific spiritual or religious beliefs required; however, attitude of nonpurposefulness is essential	No specific training period given Sessions may last from several minutes to several hours	Successful practice determined by experienced teacher; specific personal experience of the true nature of reality
MBSR	Cultivation of a "mindful" attitude Prescribed postures Seated meditation Body scan (supine posture) Hatha yoga postures	Active (diaphragmatic breathing) and passive	Seated meditation: attention focused on breath as it passes edge of nostrils or on rising and falling of abdomen Body scan: attention focused on somatic sensations in the part of the body being "scanned." Hatha yoga: attention focused on breath and the sensations that arise as different postures are assumed	No specific spiritual or religious beliefs required; however, strong commitment and self-discipline are essential	Taught in an 8-week course involving weekly 2-3 hr classes and 45-min sessions at home 6 days a week with homework exercises After course, practiced daily for 45 min Group instruction by an experienced MBSR practitioner	Successful meditation requires the technique be taught by an teacher experienced in mindfulness meditation; achievement of successful health outcomes

Table 4. Characteristics of included meditation practices (continued)

Meditation practice	Main components	Breathing	Attention	Spirituality/belief	Training	Criteria for success
Mindfulness meditation (continued)						
MBCT	Based on MBSR program Cultivation of "decentered" or "mindful" perspective Seated meditation Body scan	Passive	Seated meditation: attention focused on breath as it passes edge of nostrils or on rising and falling of abdomen Body scan: attention focused on somatic sensations in the part of the body being "scanned	No specific spiritual or religious beliefs required	Taught in an 8-week course involving weekly 2-hr classes and 45-min sessions at home 6 days a week with homework exercises Program taught in 2 main components: (1) teaching of mindfulness, (2) learning to handle mood shifts Group instruction by an experienced practitioner of mindfulness meditation	Successful meditation requires the technique be taught by an teacher experienced in mindfulness meditation; successful prevention of depressive relapse as determined by clinical evaluation
Yoga						
Kundalini yoga, Sahaja yoga, and Hatha yoga (many styles)	Emphasis of components vary among "schools" but can include ethical observances, physical postures, breathing techniques, concentrative and mindfulness meditation	Active and passive Techniques vary	Awareness for all techniques is centered on the breath Some techniques also focus on posture	No specific spiritual or religious beliefs required unless the ethical component is included	Regular daily practice from 15 min to several hours; instruction by an experienced Yogi or Guru; may take several years or longer to properly execute asanas and pranayama	Successful technique is judged by the individual or Guru against the standards for posture and breathing and against reported benefits of successful practice

Table 4. Characteristics of included meditation practices (continued)

Meditation practice	Main components	Breathing	Attention	Spirituality/belief	Training	Criteria for success
Tai Chi						
Yang, Chen, Sun, Wu (Jian Qian), and Wu (He Qin) styles	A routine of slow, deliberate movements (movements and postures vary among schools) Body relaxed, upper body erect, not bending Mouth closed, teeth not clenched	Active Nasal	Attention is focused on movement and on one's internal energy (qi)	No specific spiritual or religious beliefs required	Routines vary in number of postures and duration Classical Yang-style Tai Chi includes 108 postures and takes approximately 20-25 min to complete; practice also includes a 20-min warm-up and 10-min cooldown Should practice everyday	Proper movement and posture as judged by experienced Tai Chi teacher
Qi Gong						
Many techniques	Meditation Prescribed posture for seated meditation Movements practiced in a relaxed stationary position Breathing exercises	Active Techniques vary	Attention is focused on the "elixir field" and on the inhalation and exhalation of the breath	No specific spiritual or religious beliefs required	Practiced twice daily for 20-30 min with no single session exceeding 3 hr	Proper movement and posture as judged by experienced Qi Gong teacher Safe practice requires instruction by experienced Qi Gong teacher

Search Results for Topics II to V

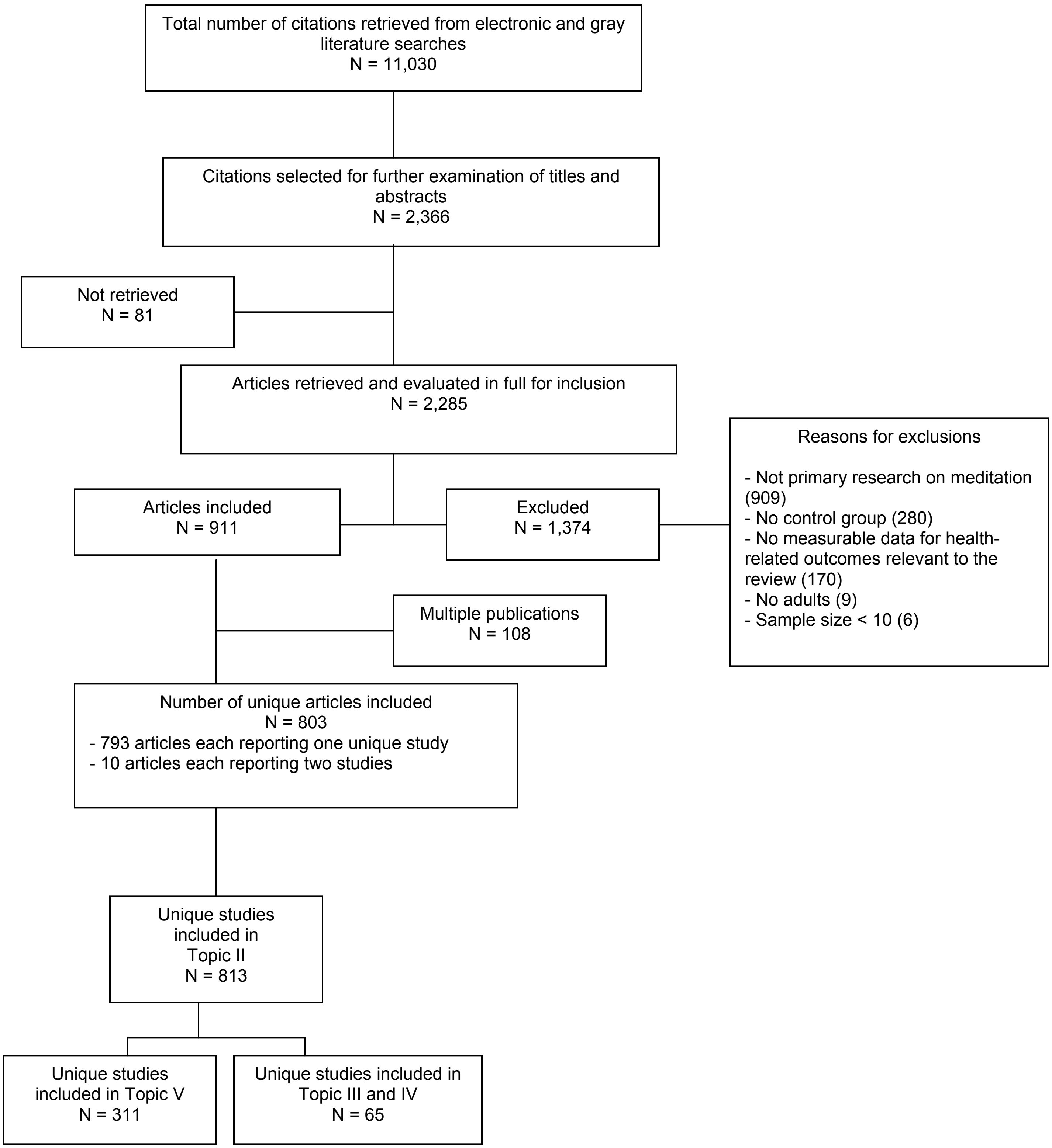
The combined search strategies identified 11,030 citations. After screening titles and abstracts, 2,366 references were selected for further examination. The manuscripts of 81 articles were not retrieved (Appendix E).* The majority of the unretrieved studies were abstracts from conference proceedings and articles from nonindexed journals and were requested through our interlibrary loan service, but did not arrive within the 9-month cutoff that we established for article retrieval. Therefore, the full text of 2,285 potentially relevant articles was retrieved and evaluated for inclusion in the review. The application of the selection criteria to the 2,285 articles resulted in 911 articles being included and 1,374 excluded. Figure 2 outlines study retrieval and selection for the review.

The primary reasons for excluding studies were as follows: (1) the study was not primary research on meditation practices (n= 909), (2) the study did not have a control group (n= 280), (3) the study did not report adequately on measurable data for health-related outcomes relevant to the review (n= 170), (4) the study did not examine an adult population (n= 9), and (5) the study sample included less than 10 participants (n= 6) (Appendix E)*. The level of agreement between reviewers for inclusion and exclusion of studies was substantial (kappa = 0.84, 95% CI, 0.80 to 0.87).

From 911 included articles, 108 were identified as multiple publications;[165] that is, cases in which the same study was published more than once, or part of data from an original report was republished.[166] The multiple publications were not considered to be unique studies and any information that they provided was included with the data reported in the main study (Appendix F).* The report that was published first was regarded as the main study. In total, 803 articles were included in this report 10 of which each reported on two studies. Therefore, this report included 813 unique studies reported in 803 articles.

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Figure 2. Flow-diagram for study retrieval and selection for the review



Topic II. State of Research on the Therapeutic Use of Meditation Practices in Healthcare

General Characteristics

Eight hundred and thirteen studies provided evidence regarding the state of research on the therapeutic use of meditation. Tables G1 to G3 of Appendix G* summarize the key characteristics of studies included in topic II.

The studies were published between 1956 and 2005, with 51 percent of the studies (n = 417) published after 1994. Most of the studies (86 percent, n = 701) were published as journal articles. Seventy-nine (10 percent) were theses or dissertations, 25 (3 percent) were abstracts from scientific conferences, and 5 (0.5 percent) were book chapters or letters. Three unpublished studies (0.5 percent) were identified by contacting investigators. Studies were conducted in North America (61 percent), Asia (24 percent), Europe (11 percent), Australasia (3 percent) and other regions (1 percent).

Of the 813 studies included, 67 percent (n = 547) were intervention studies (286 RCTs, 114 NRCTs and 147 before-and-after studies), and 33 percent (n = 266) were observational analytical studies (149 cohort and 117 cross-sectional studies).

Methodological Quality

Intervention studies. Overall, the methodological quality of the 286 RCTs was poor (median Jadad score = 2/5; IQR, 1 to 2). Only 14 percent (n = 40) of the RCTs were considered of high quality (i.e., Jadad scores greater than or equal to 3 points). Three studies[167-169] obtained 4 points on the Jadad scale, and none obtained a perfect score (5 points). The remaining 246 RCTs had a high risk of bias.

The methodological quality of the RCTs was analyzed by the individual components of the Jadad scale. We found that 21 percent (n = 60) described how the randomization was carried out. Among these 60 trials, 75 percent (n = 45) reported adequate methods to randomize study participants to treatment groups, whereas 25 percent (n = 15) used inappropriate and unreliable methods (i.e., alternation or methods based on patient characteristics) that might have introduced imbalances and jeopardized the estimates of the overall treatment effect.

The vast majority of RCTs (97 percent, n = 278) did not use double blinding to hide the identity of the assigned interventions from the participant and assessor, or hide the hypothesis from the instructor and participant or participant and assessor. One of them[170] described an inadequate method of double blinding while the others did not provide any description about the double-blinding procedures. Finally, 51 percent (n = 145) of the RCTs provided a description of withdrawals and dropouts from the study.

Concealment of treatment allocation (separating the process of randomization from the recruitment of participants) was adequately reported in 12 (4 percent) RCTs and was inadequate in 2 (1 percent) RCTs. The majority of RCTs (272, 95 percent) failed to describe how they

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*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

concealed the allocation to the interventions under study. Finally, funding source was disclosed in 41 percent (n = 118) of the RCTs. A summary of the methodological quality of RCTs is presented in Table 5.

Table 5. Methodological quality of RCTs

Quality components	N studies (%)
Randomization	286 (100)
Double blinding	8 (2.8)
Appropriate randomization	45 (15.6)
Appropriate double blinding	...
Inappropriate randomization	15 (5.2)
Inappropriate double blinding	1 (0.3)
Description withdrawals	145 (50.7)
Total Jadad score (max 5); median (IQR)	2 (1, 2)
Number of high quality RCTs (Jadad score ≥3)	40 (13.9)
Appropriate concealment of allocation	12 (4.1)
Funding reported	118 (41.3)

IQR = interquartile range; RCT = randomized controlled trial

Overall, the quality of the 114 NRCTs was low (median modified Jadad score: 0/3; IQR, 0 to 1). Forty-six percent (n = 52) of the NRCTs obtained only 1 point out of 3 for the individual components of the Jadad scale, most frequently for the description of withdrawals and dropouts. The remaining 54 percent (n = 62) of the NRCTs did not score any points. Finally, the source of funding was cited in 26 percent (n = 30) of the NRCTs. A summary of the methodological quality of NRCTs is presented in Table 6.

Table 6. Methodological quality of NRCTs

Quality components	N studies (%)
Double blinding	...
Appropriate double blinding	...
Inappropriate double blinding	...
Description withdrawals	52 (45.6)
Total modified Jadad score (max 3), median (IQR)	0 (0, 1)
Funding reported	30 (26.3)

NRCT = nonrandomized controlled trials

The quality of the 147 before-and-after studies was poor. Only 16 percent (n = 23) of the before-and-after studies included representative samples of the target population. Descriptions of the number of study withdrawals (31 percent, n = 45), reasons for study withdrawals (14 percent, n = 20), and blinding of outcome assessors to intervention and assessment periods (2 percent, n = 3) were also infrequent. Better quality results were obtained for the homogeneity in the methods for outcome assessment for the pre- and postintervention periods for all participants. Finally, funding source was disclosed in 28 percent (n = 41) of the before-and-after studies. A summary of the methodological quality of the before-and-after studies is presented in Table 7. Studies that were included in the analysis of the methodological quality of RCTs, NRCTs, and before-and-after studies are summarized in Table G4 in Appendix G.*

Table 7. Methodological quality of before-and-after studies

Quality components	N studies (%)
Study population representative of the target population	23 (15.6)
The method of outcome assessment was the same for the pre and post intervention periods for all participants	140 (95.2)
Outcome assessors were blind to intervention and assessment period	3 (2)
Description of the number of study withdrawals	45 (30.6)
Description of the reasons for study withdrawal	20 (13.6)
Funding reported	41 (27.9)

Observational analytical studies. The quality of reporting of cohort studies was evaluated with the individual components of the NOS scale regarding the selection and comparability of the cohorts, and outcome assessment. Overall, the methodological quality of the 149 cohort studies was poor (median NOS score = 3/9 stars; IQR; 2 to 4), suggesting a high risk of bias in these studies. Table 8 displays the methodological quality of the cohort studies assessed with the NOS scale.

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Table 8. Methodological quality of cohort studies (NOS scale)

	Quality components	N studies (%)
Selection of the cohorts	**Representativeness of the exposed cohort**	
	Truly representative of the average group in the community*	12 (8.1)
	Somewhat representative of the average group in the community*	43 (28.9)
	Selected group of participants	88 (59.1)
	No description of the derivation of the cohort	6 (4.0)
	Selection of the nonexposed cohort	
	Drawn from the same community as the exposed cohort*	56 (37.6)
	Drawn from a different source	79 (53.0)
	No description of the derivation of the nonexposed cohort	14 (9.4)
	Ascertainment of exposure	
	Secure record*	10 (6.7)
	Structured interview	4 (2.7)
	Written self-report	21 (14.1)
	No description of exposure ascertainment	114 (76.5)
	Ascertainment of outcome	
	Demonstration that the outcome(s) of interest was not present at the start of the study*	10 (6.7)
Comparability of the cohorts	Study controls for two or more important confounding factors*	48 (32.2)
	Study controls for at least one important confounding factor*	51 (34.2)
	No adjustment for important confounding factors in the design or analysis of the study	50 (33.6)

* Positive responses earn stars for the final score.
IQR = interquartile range; NOS = Newcastle-Ottawa Scale

Table 8. Methodological quality of cohort studies (NOS scale) (continued)

	Quality components	N studies (%)
Outcome assessment	**Assessment of outcome**	
	Independent blind assessment*	24 (16.1)
	Record linkage*	85 (57.0)
	Self-report	38 (25.5)
	No description of outcomes assessment	2 (1.3)
	Length of followup	
	Followup long enough for outcomes to occur*	44 (29.5)
	Adequacy of followup of cohorts	
	Complete followup (all subjects accounted for)*	17 (11.4)
	Subjects lost to followup unlikely to introduce bias*	12 (8.1)
	Lost to followup likely to introduce bias	8 (5.4)
	No description of losses to followup	112 (75.2)
NOS total score (max 9); median (IQR)		3 (2, 4)

In general, the cohort studies failed to protect against selection bias when assembling the exposed and nonexposed cohorts. Participants in 60 percent (n = 94) of the studies were not representative of the target population about which conclusions were to be drawn. The selection of the nonexposed cohort was equally compromised (62 percent, n = 93).

Detection bias affecting the ascertainment of both exposure and outcome was introduced in 139 (93 percent) studies. These studies did not use reliable methods to ensure that no differences in accuracy of exposure data between the cohorts existed. A similar proportion was found for studies that failed to demonstrate that the outcomes of interest were not present at the start of the study. Similarly, 105 (71 percent) cohort studies did not provide enough information to assess whether the length of the followup period was sufficient for outcomes to occur.

Attrition bias was substantial; only 20 percent (n = 29) of the studies reported followup rates unlikely to introduce differences between the comparison groups. The only methodological component that did not appear to be severely jeopardized was the control of confounders in the design or analysis. Sixty-six percent (n = 99) of the cohort studies adjusted for potential confounders either in the design or analysis. Finally, 28 percent (n = 41) of the cohort studies reported the source of funding.

The methodological quality of the cross-sectional studies was poor (median NOS total score = 2/6 stars; IQR, 1 to 3). The methodological characteristics of cross-sectional studies are summarized in Table 9. The cross-sectional studies had less prominent methodological weaknesses than the cohort studies.

Over half of the cross-sectional studies (53 percent, n = 62) chose study groups that were at least somewhat representative of the target population. However, only 21 percent of the studies (n = 24) drew the comparison groups from the same population as the study group. None of the studies used secure methods for ascertainment of exposure. Half of the cross-sectional studies (54 percent, n = 63) adjusted for potential confounders either in the design or analysis and used relatively reliable methods for assessing the outcomes (53 percent, n = 62). Finally, only 27 (23 percent) cross-sectional studies disclosed their source of funding.

Studies that were included in the analysis of the methodological quality of cohort and cross-sectional studies are summarized in Table G5 in Appendix G.*

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Table 9. Methodological quality of cross-sectional studies (NOS scale)

	Quality components	N studies (%)
Selection of the comparison groups	**Representativeness of the study group**	
	Truly representative of the average group in the community*	1 (0.9)
	Somewhat representative of the average group in the community*	61 (52.1)
	Selected group of participants	12 (10.3)
	No description of the derivation of the study group	43 (36.8)
	Selection of the comparison group	
	Drawn from the same community as the study group*	24 (20.5)
	Drawn from a different source	56 (47.9)
	No description of the derivation of the comparison group	37 (31.6)
	Ascertainment of exposure	
	Secure record*	...
	Structured interview	...
	Written self-report	2 (1.7)
	No description of exposure ascertainment	115 (98.3)
Comparability of the comparison groups	Study controls for two or more important confounding factors*	49 (41.8)
	Study controls for at least one important confounding factor*	14 (12)
	No adjustment for important confounding factors in the design or analysis of the study	54 (46.2)
Outcome assessment	**Assessment of outcome**	
	Independent blind assessment*	...
	Record linkage*	62 (53.0)
	Self-report	52 (44.4)
	No description of outcomes assessment	3 (2.6)
NOS total score (max 9); median (IQR)		2 (1, 3)

* Positive responses earn stars for the final score.
IQR = interquartile range; NOS = Newcastle-Ottawa Scale

Meditation Practices Examined in Clinical Trials and Observational Studies

Eight hundred and thirteen studies described meditation practices examined in intervention studies (RCTs, NRCTs, and before-and-after studies) and observational analytical studies (cohort and cross-sectional studies with control groups).

Overall, 86 percent (n = 698) of the studies reported on single interventions, whereas 14 percent (n = 115) reported on composite interventions. The composite interventions included either meditation practices combined with each other, or with other therapeutic strategies within holistic treatment programs. Table 10 reports the type of meditation practices that have been examined in intervention studies and observational analytical studies. Table G6 in Appendix G[*]

[*]Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

provides the references of studies included for this question along with their distribution by meditation practice and study design.

Table 10. Meditation practices examined in intervention and observational analytical studies

Meditation practice	Intervention studies (n)			Observational analytical studies (n)		Total (n)
	RCT	NRCT	Before-and-after	Cohort	Cross-sectional	
Mantra meditation	111	30	31	105	60	337
Mindfulness meditation	50	25	28	12	12	127
Meditation (ND)	11	6	2	1	1	21
Miscellaneous meditation practices	3	...	3	2	3	11
Qi Gong	13	...	9	7	8	37
Tai Chi	29	17	20	4	18	88
Yoga	69	36	54	18	15	192
Total	286	114	147	149	117	813

ND = not described; NRCT = nonrandomized controlled trials; RCT = randomized controlled trials

Mantra meditation. Forty-one percent (n = 337) of the included studies reported on interventions involving the use of a mantra as a pivotal component for the practice of meditation. The studies were published from 1972 to 2005, with 1986 the median year of publication (IQR, 1978 to 1991). Study sample sizes ranged from 10 to 602,000 participants with a median of 40 participants per study (IQR, 24 to 68).

A variety of mantra meditation techniques were assessed in the studies. The majority of the studies (68 percent, n = 230) focused on TM® or the TM®-Sidhi program. Fifteen percent (n = 51) reported on Benson's RR, and nine percent (n = 31) assessed practices in which words or phrases (mantra) were chanted aloud or silently and used as objects of attention. Mantra meditation techniques such as CSM, and SRELAX that are similar to TM®, but developed specifically for clinical purposes, were assessed in four percent (n = 12) of the studies". Acem meditation, an amalgam of traditional meditation techniques and Western psychological theory and practices, was evaluated in two percent (n = 7) of the studies. Finally, three percent of the studies focused on other mantra techniques such as Ananda Marga (n = 3), concentrative prayer (n = 2), and Cayce's meditation (n = 1).

Design and methodology. Thirty-three percent (n = 111) of the studies on mantra meditation were RCTs, 31 percent (n = 105) were cohort studies, 18 percent (n = 60) cross-sectional studies, and 9 percent for each of before-and-after studies (n = 31) and NRCTs (n = 30). The methodological quality of intervention studies on mantra meditation was poor: The median Jadad score for RCTs was 1/5 (IQR, 1 to 2). Only 13 out of 111 RCTs (12 percent) scored 3 points or more on the Jadad scale and thus could be considered high quality. The median modified Jadad score for NRCTs was 0.5/3 (IQR, 0 to 1). The quality of before-and-after studies was poor. The methodological quality of observational studies was also low, with a median NOS total score for cohort studies of 3/9 stars (IQR, 2 to 4) and a median NOS total score for cross-sectional studies of 2/6 stars (IQR, 1 to 3). There were major deficiencies in the selection and comparability of the study groups.

Mindfulness meditation. Sixteen percent of the studies (n = 127) described the use of mindfulness meditation techniques, such as MBSR (n = 49), mindfulness meditation techniques not further described (n = 37), Zen Buddhist meditation (n = 28), MBCT (n = 7), and Vipassana meditation (n = 6). The studies were published from 1964 to 2005, with a median year of publication of 2001 (IQR, 1992 to 2003). Study sample sizes ranged from 10 to 719 with a median number of 39 participants per study (IQR, 23 to 73).

Design and methodology. Thirty-nine percent (n = 50) of the studies on mindfulness meditation were RCTs, 22 percent (n = 28) were before-and-after studies, 20 percent (n = 25) NRCTs, and 9 percent for each of cohort (n = 12) and cross-sectional studies (n = 12). The methodological quality of intervention studies on mindfulness meditation was low (RCTs median Jadad score = 2/5; IQR, 1 to 2; NRCTs median modified Jadad score: 0.5/3; IQR, 0 to 1). The quality of before-and-after studies was poor. Only 7 of 50 RCTs (14 percent) scored 3 or more points in the Jadad scale and were thus considered high quality. The observational studies also exhibited major methodological shortcomings (cohort studies median NOS total score: = 3/9 stars; IQR, 2 to 4; cross-sectional studies median NOS total score: 3/6; IQR, 1 to 3), particularly in the areas of selection and comparability of the study groups.

Meditation practices not described. Three percent of the included studies (n = 21) reported on meditation practices that were not described. The studies were published from 1974 to 2004, with a median year of publication of 1998 (IQR, 1990 to 2002). Study sample sizes ranged from 10 to 230 with a median number of 46 participants per study (IQR, 27 to 97).

Design and methodology. Almost half (n = 11) of the studies were RCTs, six were NRCTs, two before-and-after studies, one cohort and one cross-sectional study. The methodological quality of the intervention studies was low (RCTs median Jadad score = 1.5/5; IQR, 1 to 2; NRCTs median modified Jadad score = 0/3; IQR, 0 to 0). Only 1 out of 11 RCTs scored 3 or more points on the Jadad scale and thus was considered high quality. The quality of before-and-after studies was poor. The cohort and cross-sectional studies obtained three and two stars on the NOS scales, respectively. Both studies failed to select unbiased study samples, thus compromising the comparability of the groups.

Miscellaneous meditation practices. One percent of the included studies (n = 11) reported on interventions that combined different meditation techniques in a single intervention. The studies were published from 1980 to 2005, with a median year of publication of 1985 (IQR, 1981 to 1993). Sample sizes ranged from 11 to 340 with a median number of participants per study of 84 (IQR, 20 to 181).

Design and methodology. Three out of 11 studies were RCTs, 3 were before-and-after studies, 2 were cohort studies, and 3 were cross-sectional studies. The methodological quality of studies on miscellaneous meditation practices showed important flaws. All RCTs scored 2 points on the Jadad scale and were considered low quality. The quality of before-and-after studies was also poor. The observational studies exhibited the same methodological flaws as the studies of other interventions described above (cohort studies median NOS total score = 3/9 stars; IQR, 1 to 3; cross-sectional studies median NOS total score = 2/6; IQR, 2 to 3).

Qi Gong. Five percent of the included studies (n = 37) reported on Qi Gong interventions. The studies were published between 1956 and 2005, with a median year of publication of 2000 (IQR, 1996 to 2004). Study sample sizes varied from 10 to 254 with a median number of 36 participants per study (IQR, 22 to 73).

Design and methodology. Thirty-five percent (n = 13) of the studies on Qi Gong were RCTs, 24 percent (n = 9) were before-and-after studies, 19 percent cohort (n = 7), and 22 percent cross-sectional studies (n = 8). The methodological quality of studies on Qi Gong was poor (RCTs median Jadad score = 1/5; IQR, 1 to 2), all scoring less than 3 points on the Jadad scale. The quality of before-and-after studies was also poor. The quality of observational studies was low (cohort studies median NOS total score = 2/9 stars; IQR, 2 to 4; cross-sectional studies median NOS total score = 2.5/6; IQR, 2 to 3). Major deficiencies were found in the selection and comparability of the study groups.

Tai Chi. Eleven percent of the included studies (n = 88) reported on Tai Chi interventions. The studies were published from 1977 to 2005, with a median year of publication of 2002 (IQR, 1998 to 2004). Study sample sizes ranged from 10 to 311 with a median number of participants per study of 39 (IQR, 25 to 65).

Design and methodology. Thirty-three percent (n = 29) of the studies on Tai Chi were RCTs, 23 percent (n = 20) were before-and-after studies, 19 percent (n = 17) NRCTs, 20 percent (n = 18) cross-sectional studies, and 4.5 percent (n = 4) were cohort studies. The methodological quality of studies on Tai Chi was poor (RCTs median Jadad score = 2/5; IQR, 1 to 3; NRCTs median modified Jadad score = 1/3; IQR, 0 to 1). Nine out of 29 RCTs scored 3 or more points on the Jadad scale and thus were considered high quality. The quality of before-and-after studies was also low. The observational studies exhibited major flaws and were likely to be affected by bias (cohort studies median NOS total score = 2/9 stars; IQR, 2 to 4; cross-sectional studies median NOS total score = 2/6; IQR, 2 to 4).

Yoga. Twenty-four percent of the included studies (n = 192) reported on interventions involving Yoga practices. The studies were published between 1968 and 2005, with a median year of publication of 1998 (IQR, 1991 to 2002). Study sample sizes ranged from 10 to 335 with a median of 40 participants (IQR, 23 to 70).

Design and methodology. Thirty-six percent (n = 69) of the studies on Yoga interventions were RCTs, 28 percent (n = 54) were before-and-after studies, 19 percent (n = 36) NRCTs, 9 percent (n = 18) cohort studies, and 8 percent (n = 15) were cross-sectional studies. The methodological quality of studies on Yoga was low (RCTs median Jadad score = 1/5; IQR, 1 to 2; NRCTs median modified Jadad score = 0/3; IQR, 0 to 1). Fourteen percent (n = 10) of the RCTs on Yoga scored 3 points or more on the Jadad scale and were considered high quality. The quality of before-and-after studies was also poor. The methodological quality of observational studies was low (cohort studies median NOS total score: = 3.5/9 stars; IQR, 2.5 to 5; cross-sectional studies median NOS total score = 3/6; IQR, 1 to 3).

Tables 11 to 15 provide a comparative summary of the methodological quality of the studies classified according to the seven categories of meditation practices described in this report.

Table 11. Methodological quality of RCTs by meditation practice*

Quality criteria	Mantra meditation (n = 111)	Mindfulness meditation (n = 50)	Meditation practices (ND) (n = 11)	Miscellaneous meditation practices (n = 3)	Qi Gong (n = 13)	Tai Chi (n = 29)	Yoga (n = 69)
Randomization; n (%)	All	All	All	All	All	All	All
Double blinding; n (%)	2 (1.2)	1 (2.0)	...	...	...	1 (3.4)	4 (5.8)
Appropriate randomization; n (%)	15 (13.3)	8 (16.0)	2	...	...	9 (31.0)	11 (15.9)
Appropriate double blinding; n (%)	...	...	...	...	...	...	...
Inappropriate randomization; n (%)	3 (2.7)	1 (2.0)	1	...	2	1 (3.4)	7 (10.1)
Inappropriate double blinding; n (%)	...	...	...	...	...	...	1 (1.4)
Description withdrawals; n (%)	50 (45.0)	27 (54.0)	5	3	8	19 (65.5)	33 (47.8)
Total Jadad score (max 5); Median (IQR)	1 (1, 2)	2 (1, 2)	1 (1, 2)	2 (2, 2)	1 (1, 2)	2 (1, 3)	1 (1, 2)
Number of high quality RCTs (Jadad scores ≥3); n (%)	13 (11.6)	7 (14.0)	1	...	...	9 (31)	10 (14.4)
Appropriate concealment of allocation; n (%)	3 (2.7)	1 (2.0)	...	...	...	3 (10.3)	5 (7.2)
Funding reported; n (%)	49 (44.1)	20 (40.0)	3	...	7	10 (34.4)	28 (40.6)

* Percentages are reported for N ≥ 20 only
IQR = interquartile range; ND = not described

Table 12. Methodological quality of NRCTs by meditation practice*

Quality criteria	Mantra meditation (n = 30)	Mindfulness meditation (n = 25)	Meditation practices (ND) (n = 6)	Tai Chi (n = 17)	Yoga (n = 36)
Double blinding; n (%)	...	...	...	...	...
Appropriate double blinding; n (%)	...	...	...	...	...
Inappropriate double blinding; n (%)	...	...	...	...	...
Description withdrawals; n (%)	15 (50.0)	14 (56.0)	-	9 (52.9)	14 (38.9)
Total modified Jadad score, (max 3); Median (IQR)	0.5 (0, 1)	1 (0, 1)	0 (0, 0)	1 (0, 1)	0 (0, 1)
Funding reported; n (%)	5 (16.7)	7 (28.0)	2	7 (41.2)	9 (25)

*Percentages are reported for N ≥ 20 only
IQR = interquartile range; ND = not described

Table 13. Methodological quality of before-and-after studies by meditation practice*

Quality criteria	Mantra meditation (n = 31)	Mindfulness meditation (n = 28)	Meditation practices (ND) (n = 2)	Miscellaneous meditation practices (n = 3)	Qi Gong (n = 9)	Tai Chi (n = 20)	Yoga (n = 54)
Study population representative of the target population; n (%)	1 (3.2)	11 (39.3)	1	2	1	4 (20)	3 (5.5)
The method of outcome assessment was the same for the pre and postintervention periods for all participants; n (%)	29 (93.5)	25 (89.3)	2	3	8	20 (100)	53 (98.1)
Outcome assessors were blind to intervention and assessment period; n (%)	2 (6.4)	...	...	...	...	1 (5)	-
Description of the number of study withdrawals; n (%)	12 (38.7)	15 (53.6)	...	3	1	6 (30)	8 (14.8)
Description of the reasons for study withdrawal; n (%)	4 (12.9)	5 (17.8)	...	2	1	4 (20)	4 (2.1)
Funding reported; n (%)	4 (12.9)	7 (25)	...	2	5	3 (15)	20 (37)

* Percentages are reported for N ≥ 20 only
ND = not described

Table 14. Methodological quality of cohort studies by meditation practice*

	Quality criteria	Mantra meditation (n = 105)	Mindfulness meditation (n = 12)	Meditation practices (ND) (n = 1)	Miscellaneous meditation practices (n = 2)	Qi Gong (n = 7)	Tai Chi (n = 4)	Yoga (n = 18)
Selection of the cohorts	Truly representative of the community; n (%)	10 (9.5)	2	...	...	...	...	...
	Somewhat representative of the community; n (%)	29 (27.6)	4	...	1	1	2	6
	Selected group of participants; n (%)	62 (59.0)	6	1	1	5	2	11
	No description of the derivation of the cohort; n (%)	4 (3.8)	...	...	...	1	...	1
	Drawn from the same community as the exposed cohort; n (%)	38 (36.2)	5	...	1	3	3	6
	Drawn from a different source; n (%)	56 (53.3)	7	...	1	4	1	10
	No description of the derivation of the nonexposed cohort	11 (10.5)	...	1	...	...	...	2
	Secure record; n (%)	7 (6.7)	1	...	...	...	...	2
	Structured interview; n (%)	...	2	...	...	...	1	1
	Written self-report; n (%)	11 (10.5)	6	...	...	1	2	1
	No description of exposure ascertainment; n (%)	87 (82.9)	3	1	2	6	1	14
	Demonstration that the outcome(s) of interest was not present at the start of the study; n (%)	7 (6.7)	1	1	...	...	...	1
Comparability	Study controls for two or more confounding factors; n (%)	32 (30.5)	3	...	1	1	2	9
	Study controls for at least one confounding factor; n (%)	39 (37.1)	2	...	...	3	1	6
	No adjustment for confounding factors in the design or analysis of the study; n (%)	34 (32.4)	7	1	1	3	1	3
Outcome assessment	Independent blind assessment; n (%)	16 (15.2)	1	...	...	2	1	4
	Record linkage; n (%)	64 (61.0)	5	...	1	4	3	8
	Self-report; n (%)	23 (21.9)	6	1	1	1	-	6
	No description of outcomes assessment; n (%)	2 (1.9)	...	...	...	...	...	...
	Followup enough for outcomes to occur; n (%)	27 (25.7)	5	1	...	1	2	8
	Complete followup (all subjects accounted for); n (%)	7 (6.7)	2	1	...	1	1	5
	Subjects lost to followup unlikely to introduce bias; n (%)	9 (8.6)	2	...	...	...	1	...

*Percentages are reported for N ≥ 20 only
ND = not described; NOS = Newcastle-Ottawa Scale

Table 14. Methodological quality of cohort studies by meditation practice (continued)

	Quality criteria	Mantra meditation (n = 105)	Mindfulness meditation (n = 12)	Meditation practices (ND) (n = 1)	Miscellaneous meditation practices (n = 2)	Qi Gong (n = 7)	Tai Chi (n = 4)	Yoga (n = 18)
Outcome assessment (continued)	Lost to followup likely to introduce bias; n (%)	6 (5.7)	1	...	...	...	...	1
	No description of losses to followup; n (%)	83 (79.0)	6	...	2	6	2	12
NOS total score (max 9); Median (IQR)		3 (2,4)	3 (2,4)	3	3 (1,3)	2 (2,4)	2 (2,4)	3.5 (2.5,5)
Funding reported; n (%)		22 (21.0)	4	...	1	4	3	7

Table 15. Methodological quality of cross-sectional studies by meditation practice*

	Quality criteria	Mantra meditation (n = 60)	Mindfulness meditation (n = 12)	Meditation practices (ND) (n = 1)	Miscellaneous meditation practices (n = 3)	Qi Gong (n = 8)	Tai Chi (n = 18)	Yoga (n = 15)
Selection of the comparison groups	Truly representative of the community; n (%)	1 (1.7)	...	...	...	...	...	...
	Somewhat representative of the community; n (%)	27 (45.0)	6*	1	3	6	13	5
	Selected group of participants; n (%)	6 (10.0)	2	...	...	2	2	2
	No description of the derivation of the study group; n (%)	26 (46.3)	4	...	...	...	3	8
	Drawn from the same community as the study group; n (%)	14 (23.3)	2	1	2	1	2	2
	Drawn from a different source; n (%)	25 (41.7)	6	...	1	6	13	5
	No description of the derivation of the comparison group; n (%)	21 (35.0)	4	...	...	1	3	8
	Secure record; n (%)	...	...	...	...	...	...	...
	Structured interview; n (%)	...	...	...	...	...	...	...
	Written self-report; n (%)	1 (1.7)	1	...	...	...	...	...
	No description of exposure ascertainment; n (%)	59 (98.3)	11	1	3	8	18	15

* Percentages are reported for N ≥ 20 only
ND = not described; NOS = Newcastle-Ottawa Scale

Table 15. Methodological quality of cross-sectional studies by meditation practice (continued)

	Quality criteria	Mantra meditation (n = 60)	Mindfulness meditation (n = 12)	Meditation practices (ND) (n = 1)	Miscellaneous meditation practices (n = 3)	Qi Gong (n = 8)	Tai Chi (n = 18)	Yoga (n = 15)
Comparability	Study controls for two or more confounding factors; n (%)	23 (38.3)	6	...	2	3	8	8
	Study controls for at least one confounding factor; n (%)	7 (11.7)	2	...	...	3	1	1
	No adjustment for confounding factors in the design or analysis of the study; n (%)	30 (50)	4	1	1	2	9	6
Outcome assessment	Independent blind assessment; n (%)	...	...	...	...	...	...	...
	Record linkage; n (%)	28 (46.7)	6	...	...	4	16	8
	Self-report; n (%)	29 (48.3)	6	1	3	4	2	7
	No description of outcomes assessment; n (%)	3 (5.0)	...	...	...	...	...	...
NOS total score (max 9); Median (IQR)		2 (1,3)	3 (1,3)	2	2 (2,3)	2.5 (2,3)	2 (2,4)	3 (1,3)
Funding reported; n (%)		6 (10)	3	...	3	4	11	3

Control Groups Used in Studies on Meditation Practices

Six hundred and sixty-eight studies contributed data for this question (402 intervention studies [RCTs and NRCTs] and 266 observational analytical studies [cohort studies and cross-sectional studies with control groups]). One hundred and forty-five studies were excluded from this analysis because they were uncontrolled before-and-after studies. Only two before-and-after studies[171,172] had controlled comparisons and were considered for the analysis of the type of control groups used in studies on meditation practices.

Overall, the number of control groups per study ranged from one to four. The median number of control groups per study was one (IQR, 1 to 2). Table 16 shows the distribution of the number of control groups by study design. The majority of studies (72 percent, n = 482) included one control group per study, 21 percent (n = 139) used two control groups, 5 percent (n = 33) used three control groups, and, 2 percent (n = 14) used four control groups.

Table 16. Number of control groups by study design

	Study design	Number of controls 1 N (%)	2 N (%)	3 N (%)	4 N (%)	Total
Intervention studies	RCTs	185 (64.7)	76 (26.4)	19 (6.6)	6 (2.0)	286
	NRCTs	88 (77.2)	20 (17.5)	1 (0.9)	5 (4.4)	114
	Controlled before-and-after	2 (100)	...	...	...	2
Observational analytical studies	Cohort studies (concurrent controls)	110 (81.5)	19 (14.1)	4 (3.0)	2 (1.5)	135
	Cohort studies (historical controls)	13 (92.9)	...	1 (7.1)	...	14
	Cross-sectional studies	84 (71.8)	24 (20.5)	8 (6.8)	1 (0.9)	117
Total		482 (72.2)	139 (20.7)	33 (4.9)	14 (2.0)	668

NRCT = nonrandomized controlled trials; RCT = randomized controlled trials.

The majority of intervention studies and observational analytical studies considered in this review used single control groups (n = 482, 72 percent) as compared to the number of studies that used multiple control groups (n = 186, 28 percent). Tables 17 and 18 display the distribution of the number of control groups used in the intervention and observational analytical studies for each meditation practice.

Table 17. Controlled intervention studies: number of control groups by meditation practice*

Meditation practice	Number of controls 1 N (%)	2 N (%)	3 N (%)	4 N (%)	Total
Mantra meditation	77 (54.2)	48 (33.5)	12 (8.3)	5 (3.4)	142
Mindfulness meditation	55 (73.3)	16 (21.3)	3 (4.0)	1 (1.3)	75
Meditation practice (ND)	10	5	1	1	17
Miscellaneous meditation practices	1	2	...	...	3
Qi Gong	12	1	...	...	13
Tai Chi	40 (87)	5 (10.9)	1 (2.2)	...	46
Yoga	80 (75.5)	19 (17.9)	3 (2.8)	4 (3.8)	106
Total	275	96	20	11	402

* Percentages are reported for N ≥ 20 only
ND = not described

Table 18. Observational analytical studies: number of control groups by meditation practice

Meditation practice	Number of controls				Total
	1 N (%)	2 N (%)	3 N (%)	4 N (%)	
Mantra meditation	136 (82.4)	23 (13.9)	5 (3.0)	1 (0.6)	165
Mindfulness meditation	17*	5	2	...	24
Meditation practice (ND)	1	...	1	...	2
Miscellaneous meditation practices	3	...	1	1	5
Qi Gong	8	2	4	1	15
Tai Chi	16	6	...	...	22
Yoga	26 (15.8)	7 (4.2)	...	...	33
Total	207	43	13	3	266

* Percentages are reported for N ≥ 20 only
ND = not described

Control groups from intervention studies (RCTs, NRCTs, and controlled before-and-after studies) were grouped into six categories according to the type of control group.[173] As some studies used more than one control group as a comparator, the number of intervention studies reported below does not match the number of control groups. Tables 19 and 20 describe the types of control groups for intervention and observational studies along with their distribution by meditation practice. Table G7 in Appendix G[*] lists the references for studies included in the description of the type of control groups for intervention studies along with their distribution by meditation practice.

Sham meditation or placebo concurrent controls. Eighteen of 402 intervention studies (four percent) compared meditation practices with elaborately designed and executed sham procedures such as sitting in a comfortable position without being instructed in the use of any sound or in directing the attention in certain way. Half of the studies (n = 9) using sham meditation or placebo control groups were conducted on mantra meditation (three on TM®, three on mantra techniques not specified, two on RR, and one on SRELAX, a technique adapted from TM®). Evaluation of other practices that used sham meditation or placebo groups included three studies on meditation practices not further described, two studies on Qi Gong, two on Yoga, one study on mindfulness meditation (Zen meditation), and one on Tai Chi.

No-treatment concurrent controls. Two types of no-treatment conditions were included in the studies: no intervention and waiting lists (WL).

No intervention controls. One hundred and twenty-four out of 402 studies (31 percent) used control groups that received no intervention of any kind. Thirty-five percent (43/123) of these studies were conducted on mantra meditation (25 studies on TM®, 8 on mantra techniques not specified, 6 on RR, 1 on Acem meditation, 1 on Cayce's meditation). There were 30 intervention studies on Yoga that used a no-intervention condition as comparator. There were 22 studies no-intervention studies on mindfulness meditation (9 studies on MBSR, 7 on mindfulness meditation practices not further specified, 5 on Zen Buddhist meditation, and 1 study on MBCT), 19 on Tai Chi, 6 on meditation practices not further described, 2 on Qi Gong, and 1 on a miscellaneous technique called "coloring mandalas."

[*]Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Waiting list controls. Sixty-two (15 percent) of the intervention studies utilized a WL control group. Twenty-four were conducted on mantra meditation (10 studies on TM®, 5 on CSM, 5 on RR, 3 on mantra techniques not specified, and 1 on SRELAX, a technique modeled after TM®); 21 on mindfulness meditation (11 studies on MBSR, 6 on mindfulness meditation practices not further specified, 2 on MBCT, and 2 on Zen Buddhist meditation); 10 on Yoga, 3 on meditation practices not further described, 2 on Qi Gong, and 2 on Tai Chi.

Active (positive) concurrent controls: interventions other than meditation. Active concurrent controls, as opposed to placebo or no treatment concurrent controls (i.e., no intervention, and waiting list conditions) were used as comparisons in 306 intervention studies (90 percent). A wide variety of active comparison groups were employed.

Exercise and other physical activities. The practice of exercise and other physical activities constituted the most frequently used comparator (45 studies). Physical activities included, but were not limited to, aerobics, running, swimming, fencing, and stretching. Eighteen studies using exercise and other physical activities as controls were conducted on Yoga, 14 on Tai Chi, and 10 on mantra meditation (3 on mantra techniques not specified, 3 on RR, 2 on TM®, 1 on Acem meditation, 1 on CSM). One study was conducted on MBSR, one on meditation practices not specified, and one on Qi Gong.

Rest and states of relaxation. Conditions involving states of rest and relaxation were used as controls in 45 studies. There were 28 studies on mantra meditation (14 on RR, 9 on TM®, 3 on mantra techniques not specified, and 2 on CSM), 9 on Yoga, 6 on mindfulness meditation (3 on Zen Buddhist meditation, 2 on mindfulness meditation techniques not further specified, and 1 on MBSR), and 2 on other meditation practices not further described.

Educational activities. Forty-four studies used educational activities such as lectures and courses on stress management, nutrition, health, and wellness as comparators. Seventeen of these studies were conducted on mantra meditation (9 on TM®, 5 on RR, 2 on mantra techniques not specified, and 1 on CSM), 10 studies on mindfulness meditation (5 studies on MBSR, 3 on Zen Buddhist meditation, and 2 on mindfulness meditation techniques not further specified), 8 on Yoga, 6 on Tai Chi, 2 on meditation practices not further described, and 2 on miscellaneous meditation techniques.

Progressive muscle relaxation. The practice of progressive muscle relaxation (PMR) was chosen as a control group in 39 intervention studies. The majority of studies (n = 27) using PMR as a control were conducted on mantra meditation (10 on TM®, 8 on RR, 5 on mantra techniques not specified, 3 on CSM, and 1 on Acem meditation). There were also six studies on Yoga, five on mindfulness meditation (two on MBSR, two on mindfulness meditation techniques not further specified, and one on Zen Buddhist meditation), and one study on a meditation practice not further described.

Cognitive behavioral techniques. Twenty studies employed cognitive behavioral interventions as comparison groups. Nine of these studies were conducted on mantra meditation (three on TM®, three on RR, two on CSM, and one on mantra techniques not specified). There were seven intervention studies on mindfulness meditation (four on mindfulness meditation techniques not further specified, and three on MBSR). There were two studies on meditation practices not further described, and two studies on Yoga.

Pharmacological interventions. Eight studies used comparators involving pharmacological interventions such as antihypertensive medication, lipid-lowering medication, antidepressants, and other medications that were not described. There were six studies on Yoga, and two on Qi Gong that used a pharmacological intervention as a control.

Miscellaneous active controls. Nineteen studies reported on the use of control groups that involved a heterogeneous collection of active interventions, such as charting, creativity techniques, herbal therapy, visualization and other imagery, and cognitive tasks. Six of these studies were conducted on mantra meditation (three on RR, two on mantra techniques not specified, and one on TM®). There were also six studies on Yoga, four studies on mindfulness meditation (two on MBSR, one on Zen Buddhist meditation, and one on mindfulness meditation techniques not further specified), two on miscellaneous meditation practices, one on Tai Chi, and one on a meditation practice not further described.

Group therapy and psychotherapy. Sixteen studies used psychotherapeutic interventions such as group therapy (13 studies) and individual psychotherapy (3 studies) as comparison groups. Among the 13 studies that used group therapy as a control, 6 were on mantra meditation (3 on RR, 2 on TM®, and 1 on Acem meditation), 3 on mindfulness meditation (2 on mindfulness meditation techniques not further specified, and one on MBSR). There were also three studies on Tai Chi and two on Yoga that used group therapy as a comparator. Generally, group therapy was delivered as a form of group counseling and psychosocial support. Individual psychotherapeutic approaches were used as control groups in one study on mantra meditation (TM®), one study on MBSR, and one study on Yoga.

Biofeedback techniques. The practice of biofeedback (BF) techniques such as electromyographic (EMG) BF, and blood pressure BF was used as comparators in 12 intervention studies. The majority of the studies (n = 11) were conducted on mantra meditation (six on RR, three on mantra techniques not specified, and two on TM®) and one was conducted on Yoga.

Reading. Activities involving reading were utilized as controls in eight studies. There were six studies on mantra meditation (four on RR, and two on TM®), one on Tai Chi, and one on Yoga.

Hypnosis. Hypnosis was selected as a control group in four intervention studies: two on mantra meditation (TM®) and two on meditation practices not further described.

Therapeutic massage and acupuncture. Three studies used complementary interventions such as massage (two studies; one on RR, and another on MBSR) and acupuncture (one on Tai Chi) as comparison groups.

Usual care. Thirty-seven intervention studies included a group of usual care in their comparisons. Nine of these studies were conducted on mindfulness meditation (3 on MBCT, 2 on mindfulness meditation techniques not further specified, 2 on MBSR, and 1 on Zen Buddhist meditation), 3 on Qi Gong, 3 on mantra meditation (2 on TM® and 1 on RR), 4 on Tai Chi, 16 on Yoga, and one on meditation practices not further described

Other control groups. Six studies reported on the comparison groups in terms of controls without providing further comprehensive details. Two of these studies were conducted on mantra meditation (one on RR and one on TM®), two on Qi Gong, one on mindfulness meditation not further specified, and one on Tai Chi.

Active (positive) concurrent controls: meditation practices as comparison groups. Forty-three studies used meditation practices as control groups. Fourteen of these studies compared two different meditation practices against each other. Twenty-nine studies compared two versions of the same meditation practice but varied certain components of the practice, e.g., method of delivery, intensity, and length of session, of the comparison group. The former category of studies is described first and the latter is described under the category of "different dose or response concurrent control groups."

Yoga practices. Four studies (three on TM® and one on mantra techniques not specified) compared mantra meditation techniques versus Yoga techniques such as Savasana. One study compared Hatha yoga versus a meditation practice not further described.

Mantra meditation. Three studies on Yoga (Kundalini, Sahaja, and Hatha yoga) used a mantra meditation technique for their comparison groups; two of them used RR[169,174] the third [175] used a mantra technique not further described.

Mindfulness meditation. Two studies on mantra meditation (TM® and a mantra technique not further described) used interventions described as "mindfulness training" as comparison groups. Another study on a meditation practice not further described used mindfulness meditation as the comparison group.

Meditation practices not described. Two studies on mantra meditation (one on RR, and the other on TM®) failed to describe the type of meditation practice chosen for the comparison group.

Tai Chi: One study on mantra meditation (RR) used a Tai Chi-based intervention for the comparison group.

Different dose or regimen: concurrent control groups. Twenty-nine studies compared similar meditation practices but modified certain components of the practices to create the comparison groups.

Yoga practices. Fourteen studies compared different types of Yoga practices with each other. Nine studies[140,176-183] compared different patterns of yogic nostril breathing techniques (e.g., unilateral versus bilateral nostril breathing, left versus right forced unilateral nostril breathing), whereas five studies compared different modalities of yoga practice such as Hatha versus Astanga,[127] different formats for practice (e.g., full Sudarshan Kriya versus partial Sudarshan Kriya),[184] or combinations with other therapeutic strategies.[111,175,185]

Mantra meditation. Nine studies on mantra meditation compared different formats for the delivery of practice. Three studies[186-188] on TM® examined either short- versus long-term or regular versus irregular practice. Two other studies on TM®[189,190] included RR as one of the comparators. There were two studies on RR that used TM®[191] or modifications of the RR technique[192] as comparison groups. One study on CSM[193] used a RR control group. The remaining study on mantra meditation[194] did not describe the practices being compared.

Mindfulness meditation. Four studies on mindfulness meditation used other mindfulness meditation techniques as control groups. There were two studies on MBSR,[195,196] one on Zen Buddhist meditation,[197] and one[197] that did not describe the mindfulness techniques being compared.

Meditation practice not described. Two studies[198,199] failed to provide a clear description of the meditation practices being compared.

Multiple control groups. As was shown in Table 16, 275 out of 402 intervention studies used a single control group, whereas 127 used more than one kind of control (e.g., used one active and one inactive control). Sixty-five of the intervention studies with multiple controls were conducted on mantra meditation (25 on TM®, 22 on RR, 12 on mantra techniques not further described, 4 on CSM, 1 on Acem meditation, and 1 on SRELAX). There were 26 studies with multiple controls conducted on Yoga, 20 studies on mindfulness meditation (8 on MBSR, 6 on mindfulness meditation techniques not further specified, and 6 on Zen Buddhist meditation), 7 studies on meditation practices not further described, 6 on Tai Chi, 2 on miscellaneous meditation practices, and 1 on Qi Gong.

Control groups from observational analytical studies (cohort and cross-sectional studies) were also classified according to the type of comparison used.[173] As some studies used more than one control group as a comparator, the number of observational analytical studies reported below is less than the number of control groups. Table G8 in Appendix G provides the references for studies included in the description of the type of control groups in observational analytical studies along with their distribution by meditation practice.*

Unexposed controls. The vast majority of observational analytical studies (92 percent, 244/266) used comparison groups consisting of individuals that were not been exposed to any type of meditation practice. Sixty-three percent (153/244) of these studies examined mantra meditation (140 studies on TM®, 6 on mantra techniques not specified, 4 on Acem meditation, and 3 on Ananda Marga meditation). There were 29 observational analytical studies on Yoga that used a group of unexposed individuals as a comparator, 21 studies where the exposed group practiced mindfulness meditation (12 on Zen Buddhist meditation, 6 on mindfulness meditation techniques not further specified, and 3 studies on Vipassana meditation), 21 on Tai Chi, 13 on Qi Gong, 5 on miscellaneous practices combining different meditation practices, and 2 on meditation practices not further described.

Active (positive) controls using interventions other than meditation practice. Thirty-seven observational analytical studies utilized control groups consisting of practitioners of techniques other than meditation.

Exercise and other physical activities. Practitioners of exercise and other physical activities constituted the most frequent active comparator (14 studies). Four studies examined Tai Chi practitioners, four studies examined Yoga practitioners, and two studies examined subjects practicing a miscellaneous group of meditation techniques. Two studies examined TM® practitioners, one examined practitioners of meditation techniques not specified, and one examined Qi Gong practitioners. The type of physical activities practiced by the control groups included aerobic and anaerobic exercises, swimming, running, and golfing.

Miscellaneous active controls. Five studies used control groups consisting of practitioners of martial arts, concentration, and creativity techniques. Three of these studies used practitioners of mantra meditation, specifically TM®, as exposed groups. One study examined practitioners of Tai Chi and one practitioners of miscellaneous meditation techniques.

Other comparison groups consisted of individuals exposed to a variety of practices not considered meditation. Four studies on TM® used a group of practitioners of *PMR* as a control group. Three studies on TM® included participants that underwent *hypnosis therapy*. Three studies on TM® used groups of participants exposed to conditions of *rest and relaxation* for their comparisons. One study on Qi Gong and one on Yoga included participants in *educational activities*. Group therapy participants were included for comparison in one study on TM® and in one on Yoga. Individuals involved in *reading* activities were used as controls in one study of Zen Buddhist meditation, and in one study of Yoga. Finally, practitioners of BF and cognitive behavioral techniques such as sensitivity training acted as controls in, respectively, one study of RR and one study of TM®.

Active (positive) controls exposed to other meditation practices. Forty-seven studies used active control groups of practitioners of a variety of meditation techniques. Eleven of these studies compared groups of practitioners of different meditation techniques against each other. Thirty-six observational analytical studies compared groups of practitioners of the same meditation technique but with different lengths of practice. The former group of studies is

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

described immediately below and the latter is described under "Concurrent control groups exposed to different dose or regimen of the same meditation practice."

Practitioners of mantra meditation (TM® and a mantra technique not specified) were used as the comparison group in two observational studies on mindfulness meditation (one on Zen Buddhist meditation and the other on a mantra technique not further described).

There were two studies (one on TM® and the other on a mantra technique not further described) that used mindfulness meditation practitioners as control groups. Two other studies (one on Yoga, and the other on a meditation practice not described) failed to describe the type of meditation technique practiced by the comparison group. One study on Qi Gong used Tai Chi practitioners for comparisons, and Yoga practitioners were used as control groups in two studies on TM®, one on Zen Buddhist meditation, and one on Qi Gong.

Concurrent control groups exposed to different dose or regimen of the same meditation practice. Thirty-six studies made comparisons between groups of practitioners of the same meditation practice but using different lengths of practice (e.g., short-term versus long-term). Twenty of these studies were on mantra meditation (17 on TM®, 2 on Ananda Marga, and 1 on a mantra technique not further described), 6 on mindfulness meditation (4 on Zen Buddhist meditation, 1 on Vipassana meditation, and 1 on a Mindfulness meditation technique not further specified), 6 on Qi Gong, 3 on Yoga, and 1 on Tai Chi.

Historical controls. Fourteen out of 266 observational analytical studies used historical controls consisting of groups of participants external to the study or of the same single group of participants with data collected at an earlier period of time. Eleven of these studies compared mantra meditation (nine on TM® and one on Ananda Marga) to data from nonmeditators collected earlier for other purposes. Three studies on Qi Gong also used nonconcurrent data from nonpractitioners,[200,201] Yoga practitioners,[202] groups of athletes and participants in educational lectures.[202]

Multiple control groups. As shown earlier in Table 16, 207 out of 266 observational analytical studies used a single control group, whereas 59 used more than one kind of control per study (e.g., use of either active controls or inactive interventions).

Twenty-nine of the observational analytical studies with multiple controls were conducted on mantra meditation (25 on TM®, 2 on Ananda Marga, and 2 on mantra techniques not further described). There were seven studies with multiple controls conducted on mindfulness meditation (five on Zen Buddhist meditation, one on mindfulness meditation techniques not further described, and one on Vipassana meditation), seven on Yoga, seven on Qi Gong, six on Tai Chi, two on miscellaneous interventions, and one on meditation practices not further described.

Table 19. Types of control groups for intervention studies on meditation practices

Type of control group	N groups	N studies	Meditation practice (no. studies)
Placebo/sham	18	18	Mantra meditation (9 groups, 9 studies) TM® (3), Mantra (NS) (3), RR (2), SRELAX (1), Meditation practices (ND) (3 groups, 3 studies) Yoga (2 groups, 2 studies) Mindfulness meditation (1 group, 1 study) Zen Buddhist meditation (1) Qi Gong (2 groups, 2 studies) Tai Chi (1 group, 1 study)
No-treatment concurrent controls			
NT	126	123	Mantra meditation (44 groups, 43 studies) TM® (25), Mantra (NS) (8); RR (6), CSM (2), Acem meditation (1), Cayce's meditation (1) Yoga (31 groups, 30 studies) Mindfulness meditation (23 groups, 22 studies) MBSR (9), MM (NS) (7), Zen Buddhist meditation (5), MBCT (1) Tai Chi (19 groups, 19 studies) Meditation practices (ND) (6 groups, 6 studies) Qi Gong (2 groups, 2 studies) Miscellaneous meditation practices (1 group, 1 study)
WL	62	62	Mantra meditation (24 groups, 24 studies) TM® (10), CSM (5), RR (5), Mantra (NS) (3), SRELAX (1) Mindfulness meditation (21 groups, 21 studies) MBSR (11), MM (NS) (6),MBCT (2), Zen Buddhist meditation (2) Yoga (10 groups, 10 studies) Meditation practices (ND) (3 groups, 3 studies) Qi Gong (2 groups, 2 studies) Tai Chi (2 groups, 2 studies)
Active (positive) concurrent controls—interventions other than meditation practices			
Exercise/physical activity	52	45	Yoga (23 groups, 18 studies) Tai Chi (14 groups, 14 studies) Mantra meditation (13 groups, 10 studies) Mantra (NS) (3), RR (3), TM® (2), Acem meditation (1), CSM (1) Mindfulness meditation (1 group, 1 study) MBSR (1) Meditation practices (ND) (1 group, 1 study) Qi Gong (1 group, 1 study)
Rest and states of relaxation	47	45	Mantra meditation (30 groups, 28 studies) RR (14), TM® (9), Mantra (NS) (3), CSM (2) Yoga (9 groups, 9 studies) Mindfulness meditation (6 groups, 6 studies) Zen Buddhist meditation (3), MM (NS) (2), MBSR (1) Meditation practices (ND) (2 groups, 2 studies)

BF = biofeedback; CSM = Clinically Standardized Meditation; MBCT = mindfulness-based cognitive therapy; MBSR = Mindfulness-based stress reduction; MM = mindfulness meditation; = ND = not described; NS = not specified; NT = no treatment; PMR = progressive muscle relaxation; RR = Relaxation Response; TM® = Transcendental Meditation®; WL = waiting list

Table 19. Types of control groups for intervention studies on meditation practices (continued)

Type of control group	N groups	N studies	Meditation practice (no. studies)
Active (positive) concurrent controls—interventions other than meditation practices (continued)			
Education	46	44	Mantra meditation (19 groups, 17 studies) TM® (9), RR (5), Mantra (NS) (2), CSM (1) Mindfulness meditation (10 groups, 10 studies) MBSR (5), Zen Buddhist meditation (3), MM (NS) (2) Yoga (8 groups, 8 studies) Tai Chi (6 groups, 6 studies) Meditation practices (ND) (2 groups, 2 studies) Miscellaneous meditation practices (1 groups, 1 study)
PMR	39	39	Mantra meditation (27 groups, 27 studies) TM® (10), RR (8), Mantra (NS) (5), CSM (3), Acem meditation (1) Yoga (6 groups, 6 studies) Mindfulness meditation (5 groups, 5 studies) MBSR (2), MM (NS) (2), Zen Buddhist meditation (1) Meditation practices (ND) (1 group, 1 study)
Cognitive behavioral techniques	22	20	Mantra meditation (9 groups, 9 studies) TM® (3), CSM (2), Mantra (NS) (1) Mindfulness meditation (7 groups, 7 studies) MM (NS) (4), MBSR (3) Meditation practices (ND) (3 groups, 2 studies) Yoga (3 groups, 2 studies)
Miscellaneous active controls	23	19	Yoga (7 groups, 6 studies) Mantra meditation (6 groups, 6 studies) RR (3), Mantra (NS) (2), TM® (1) Mindfulness meditation (6 groups, 4 studies) MBSR (2), Zen Buddhist meditation (1), MM (NS) (1) Miscellaneous meditation practices (2 groups, 1 study) Meditation practices (ND) (1 group, 1 study) Tai Chi (1 group, 1 study)
Group therapy	14	13	Mantra meditation (6 groups, 6 studies) RR (3), TM® (2), Acem meditation (1) Mindfulness meditation (3 groups, 3 studies) MBSR (1), MM (NS) (2) Tai Chi (3 groups, 2 studies) Yoga (2 groups, 2 studies)
Psychotherapy	3	3	Mantra meditation (1 group, 1 study) TM® (1) Mindfulness meditation (1 group, 1 study) MBSR (1) Yoga (1 group, 1 study)
BF	13	12	Mantra meditation (12 groups, 11 studies) RR (6), Mantra (NS) (3), TM® (2), Yoga (1 group, 1 study)
Reading	8	8	Mantra meditation (6 groups, 6 studies) RR (4), TM® (2) Tai Chi (1 group, 1 study) Yoga (1 group, 1 study)
Pharmacological interventions	8	8	Yoga (6 groups, 6 studies) Qi Gong (2 groups, 2 studies)
Hypnosis	4	4	Mantra meditation (2 groups, 2 studies) TM® (2) Meditation practices (ND) (2 groups, 2 studies)

Table 19. Types of control groups for intervention studies on meditation practices (continued)

Type of control group	N groups	N studies	Meditation practice (no. studies)
Active (positive) concurrent controls—interventions other than meditation practices (continued)			
Massage	3	2	Mantra meditation (2 groups, 1 study) RR (1) Mindfulness meditation (1 group, 1 study) MBSR (1)
Acupuncture	1	1	Tai Chi (1 group, 1 study)
Active (positive) concurrent controls—meditation practices as comparison groups			
Yoga	5	5	Mantra meditation (4 groups, 4 studies) TM® (3), Mantra (NS) (1) Meditation practices (ND) (1 group, 1 study)
Mantra meditation	3	3	Yoga (3 groups, 3 studies)
Mindfulness meditation	3	3	Mantra meditation (2 groups, 2 studies) TM® (1), Mantra (NS) (1) Meditation practices (ND) (1 group, 1 study)
Meditation practices (ND)	2	2	Mantra meditation (2 groups, 2 studies) RR (1), TM® (1)
Tai Chi	1	1	Mantra meditation (1 group, 1 study) RR (1)
Different dose or regimen of meditation practices—concurrent control groups			
Yoga	15	14	Yoga (15 groups, 14 studies)
Mantra meditation	9	9	Mantra meditation (9 groups, 9 studies) TM® (5), RR (2), CSM (1), Mantra (NS) (1)
Mindfulness meditation	5	4	Mindfulness meditation (5 groups, 4 studies) MBSR (2), Zen Buddhist meditation (1), MM (NS) (1)
Meditation practices (ND)	2	2	Meditation practices (ND) (2 groups, 2 studies)
Usual care	37	37	Mindfulness meditation (9 groups, 9 studies) MM (NS) (2), MBSR (3), MBCT (3), Zen Buddhist (1) Qi Gong (3 groups, 3 studies) Mantra meditation (2 groups, 2 studies) RR (1), TM® (2) Tai Chi (4 groups, 4 studies) Yoga (16 groups, 16 studies) Meditation practices (ND) (1 group, 1 study) Miscellaneous meditation practices (1 group, 1 study)
Control groups (ND)	6	6	Mantra meditation (2 groups, 2 studies) RR (1), TM® (1) Qi Gong (2 groups, 2 studies) MM (NS) (1) Tai Chi (1 groups, 1 studies)
Number of controls per study			
Single control	275	275	Yoga (80 groups, 80 studies) Mantra meditation (77 groups, 77 studies) TM® (34), RR (23), Mantra (NS) (9), CSM (6), Acem meditation (2), Cayce's meditation (1) Mindfulness meditation (55 groups, 55 studies) MBSR (25), MM (NS) (18), MBCT (6), Zen Buddhist meditation (6), Tai Chi (40 groups, 40 studies) Qi Gong (12 groups, 12 studies) Meditation practices (ND) (10 groups, 10 studies) Miscellaneous meditation practices (1 group, 1 study)

Table 19. Types of control groups for intervention studies on meditation practices (continued)

Type of control group	N groups	N studies	Meditation practice (no. studies)
Number of controls per study (continued)			
Multiple controls	296	127	Mantra meditation (152 groups, 65 studies) TM® (25), RR (22), Mantra (NS) (11), Acem meditation (1), SRELAX (1) Yoga (63 groups, 26 studies) Mindfulness meditation (45 groups, 20 studies) MBSR (8), MM (NS) (6), Zen Buddhist meditation (6) Meditation practices (ND) (17 groups, 7 studies) Tai Chi (13 groups, 6 studies) Miscellaneous meditation practices (4 groups, 2 studies) Qi Gong (2 groups, 1 study)

Table 20. Types of control groups for observational analytical studies on meditation practices

Type of control group	N groups	N studies	Meditation practice (no. studies)
Nonexposed cohorts/comparison groups	247	244	Mantra meditation (155 groups, 153 studies) TM® (140), Mantra (NS) (6), Acem meditation (4), Ananda marga (3) Yoga (29 groups, 29 studies) Mindfulness meditation (21 groups, 21 studies) Zen Buddhist meditation (12), MM (NS) (6), Vipassana (3) Tai Chi (22 groups, 21 studies) Qi Gong (13 groups, 13 studies) Miscellaneous meditation practices (5 groups, 5 studies) Meditation practices (ND) (2 groups, 2 studies)
Active (positive) concurrent controls exposed to interventions other than meditation practices			
Exercise/physical activity	16	14	Tai Chi (4 groups, 4 studies) Yoga (4 groups, 4 studies) Miscellaneous meditation practices (4 groups, 2 studies) Mantra meditation (2 groups, 2 studies) TM® (2) Meditation practices (ND) (1 group, 1 study) Qi Gong (1 group, 1 study)
Miscellaneous active controls	7	5	Mantra meditation (5 groups, 3 studies) TM® (3) Miscellaneous meditation practices (1 group, 1 study) Tai Chi (1 group, 1 study)
Progressive muscle relaxation	5	4	Mantra meditation (5 groups, 4 studies) TM® (4)
Hypnosis	3	3	Mantra meditation (3 groups, 3 studies) TM® (3)
Rest and states of relaxation	3	3	Mantra meditation (3 groups, 3 studies) TM® (3)
Education	2	2	Qi Gong (1 group, 1 study) Yoga (1 group, 1 study)

MM = mindfulness meditation; ND = not described; NS = not specified; RR = Relaxation Response; TM® = Transcendental Meditation®

Table 20. Types of control groups for observational analytical studies on meditation practices (continued)

Type of control group	N groups	N studies	Meditation practice (no. studies)
Active (positive) concurrent controls exposed to interventions other than meditation practices			
Group therapy	2	2	Mantra meditation (1 group, 1 study) TM® (1) Yoga (1 group, 1 study)
Reading	2	2	Mindfulness meditation (1 group, 1 study) Zen Buddhist meditation (1) Yoga (1 group, 1 study)
Biofeedback	1	1	Mantra meditation (1 group, 1 study) RR (1)
Cognitive behavioral techniques	1	1	Mantra meditation (1 group, 1 study) TM® (1)
Active (positive) concurrent controls exposed to meditation practices			
Mantra meditation	2	2	Mindfulness meditation (2 groups, 2 studies) Zen Buddhist meditation (1), MM (NS) (1)
Mindfulness meditation	2	2	Mantra meditation (2 groups, 2 studies) TM® (1), Mantra (NS) (1)
Meditation practices (ND)	2	2	Yoga (1 group, 1 study) Meditation practices (ND) (1 group, 1 study)
Tai Chi	1	1	Qi Gong (1 group, 1 study)
Yoga	4	4	Mantra meditation (2 groups, 2 studies) TM® (2) Mindfulness meditation (1 group, 1 study) Zen Buddhist meditation (1) Qi Gong (1 group, 1 study)
Concurrent control groups exposed to different dose or regimen of the same meditation practice			
Mantra meditation	21	20	Mantra meditation (21 groups, 20 studies) TM® (17), Ananda marga (2), Mantra (NS) (1)
Mindfulness meditation	8	6	Mindfulness meditation (8 groups, 6 studies) Zen Buddhist meditation (4), Vipassana (1), MM (NS) (1)
Qi Gong	11	6	Qi Gong (11 groups, 6 studies)
Yoga	3	3	Yoga (3 groups, 3 studies)
Tai Chi	1	1	Tai Chi (1 group, 1 study)
Historical controls	14	14	Mantra meditation (11 groups, 11 studies) TM® (10), Ananda marga (1) Qi Gong (3 groups, 3 studies)

Table 20. Types of control groups for observational analytical studies on meditation practices (continued)

Type of control group	N groups	N studies	Meditation practice (no. studies)
Number of controls per study			
Single control	207	207	Mantra meditation (136 groups, 136 studies) TM® (126), Acem meditation (4), Mantra (NS) (4), Ananda marga (1), RR (1) Yoga (26 groups, 26 studies) Mindfulness meditation (17 groups, 17 studies) Zen Buddhist meditation (8), MM (NS) (6), Vipassana (3) Tai Chi (16 groups, 16 studies) Qi Gong (8 groups, 8 studies) Miscellaneous meditation practices (3 groups, 3 studies) Meditation practices (ND) (1 group, 1 study)
Multiple controls	137	59	Mantra meditation (65 groups, 29 studies) TM® (25), Ananda marga (2), Mantra (NS) (2) Mindfulness meditation (16 groups, 7 studies) Zen Buddhist meditation (5), MM (NS) (1), Vipassana (1) Yoga (14 groups, 7 studies) Qi Gong (20 groups, 7 studies) Tai Chi (12 groups, 6 studies) Miscellaneous meditation practices (7 groups, 2 studies) Meditation practices (ND) (3 groups, 1 study)

Meditation Practices Separated by the Diseases, Conditions, and Populations for Which They Have Been Examined

Eight hundred and thirteen studies contributed to the description of the diseases, conditions, and populations for which meditation practices have been examined.

Overall, 69 percent (n = 564) of the studies included healthy participants only, whereas 30 percent (n = 244) reported on clinical populations. Five studies (0.6 percent) included both healthy and clinical participants in the study populations. Overall, the median number of participants per study was 40 (IQR, 23 to 71), with a median age of 37 years (IQR, 26 to 50; n = 536). Both male and females were equally represented in the studies (median number of males per study, 19; IQR, 10 to 36; median number of females per study, 19; IQR, 7 to 39).

Table 21 displays the diseases, conditions, and populations that have been examined in intervention and observational analytical studies on meditation practices.

Table 21. Types of populations and conditions included in studies on meditation

Category of interest	Study condition	Intervention studies	Observational analytical studies	Total	Total studies per category
Circulatory and cardiovascular	Hypertension	35	2	37	61
	Other cardiovascular diseases	24	...	24	

COPD = chronic obstructive pulmonary disease; HIV = human immunodeficiency virus; NS = not specified

Table 21. Types of populations and conditions included in studies on meditation (continued)

Category of interest	Study condition	Intervention studies	Observational analytical studies	Total	Total studies per category
Dental	Dental problems (NS)	1	...	1	2
	Periodontitis	...	1	1	
Dermatology	Psoriasis	3	...	3	3
Endocrine	Obesity	1	...	1	11
	Type II diabetes mellitus	10	...	10	
Gastrointestinal	Gastrointestinal disorders	1	...	1	3
	Irritable bowel syndrome	2	...	2	
Gynecology	Infertility	1	...	1	10
	Menopause	2	...	2	
	Postmenopause	1	3	4	
	Pregnancy	1	1	2	
	Premenstrual syndrome	1	...	1	
Healthy	College and university students	123	65	189	553
	Elderly	34	26	60	
	Healthy volunteers	90	160	250	
	Army and military	8	...	8	
	Prison inmates	7	3	10	
	Workers	25	3	28	
	Athletes	6	...	6	
	Smokers	3	...	3	
Immunologic	HIV	3	...	3	3
Sleep disorders	Insomnia	2	...	2	5
	Chronic insomnia	3	...	3	
Mental health disorders	Anger management	1	...	1	66
	Anxiety disorders	14	...	14	
	Binge eating disorder	3	...	3	
	Burnout	1	...	1	
	Depression	11	...	11	
	Miscellaneous psychiatric conditions	6	1	7	
	Mood disorders	3	...	3	
	Neurosis	1	...	1	
	Obsessive-compulsive disorder	1	...	1	
	Parents of children with behavior problems	1	...	1	
	Personality disorders	1	...	1	
	Postraumatic stress disorders	1	...	1	
	Psychosis	1	...	1	

Table 21. Type of populations and conditions included in studies on meditation (continued)

Category of interest	Study condition	Intervention studies	Observational analytical studies	Total	Total studies per category
Mental health disorders (continued)	Schizophrenia	1	...	1	
	Schizophrenia AND antisocial personality disorders	1	...	1	
	Substance abuse	18	...	18	
Miscellaneous medical conditions	Heterogeneous patient population	10	...	10	11
	Chronic fatigue	1	...	1	
Musculoskeletal	Balance disorders	1	...	1	42
	Carpal tunnel syndrome	1	...	1	
	Multiple sclerosis	2	...	2	
	Muscular dystrophy	1	...	1	
	Chronic pain	10	1	11	
	Chronic rheumatic diseases	1	...	1	
	Fibromyalgia	10	...	10	
	Regional pain syndrome	1	...	1	
	Rheumatoid arthritis	6	...	6	
	Hyperkyphosis	1	...	1	
	Osteoarthritis	4	...	4	
	Osteoporosis	1	...	1	
	Postpolio syndrome	1	...	1	
	Total hip and knee replacement	1	...	1	
Neurological	Developmental disabilities	1	...	1	10
	Epilepsy	2	...	2	
	Migraine and tension headaches	3	...	3	
	Stroke	2	...	2	
	Traumatic brain injuries	2	...	2	
Oncology	Cancer	12	...	12	12
Organ transplant	Organ transplantation	1	...	1	1
Renal	End-stage renal disease	1	...	1	1
Respiratory and pulmonary	Asthma	11	...	11	16
	COPD	1	...	1	
	Chronic airways obstruction	1	...	1	
	Chronic bronchitis	1	...	1	
	Pleural effusion	1	...	1	
	Pulmonary tuberculosis	1	...	1	
Vestibular	Tinnitus	2	...	2	3

Table 21. Type of populations and conditions included in studies on meditation (continued)

Category of interest	Study condition	Intervention studies	Observational analytical studies	Total	Total studies per category
	Vestibulopathy	1	...	1	
Total		547	266	813	813

In general, the majority of studies (68 percent) on meditation practices have been conducted in healthy populations such as college and university students, healthy elderly participants from the community, army and military personnel, prison inmates, workers, athletes, and smokers (553 studies comprising 196 intervention studies and 257 observational analytical studies). Individuals with mental health disorders constituted the second most studied population (and the most frequently studied category of clinical conditions) examined in studies on meditation practices (66 studies: 65 intervention studies, and 1 observational analytical study). Mental health conditions included substance abuse, anxiety disorders, depression, and binge eating disorders, among others.

People with cardiovascular and circulatory conditions were the third most studied population and the second most frequently studied clinical condition (61 studies comprising 59 intervention studies and 2 observational analytical studies). There were 37 studies on hypertensive participants (35 intervention studies and 2 observational analytical studies). Cardiovascular conditions (24 intervention studies) included hypertension and a group of heterogeneous cardiovascular diseases (diseases of the circulatory system—the heart, the blood vessels of the heart, and the veins and arteries throughout the body and within the brain) such as coronary artery disease, chronic heart failure, ischemic heart disease, and myocardial infarction.

Forty-two studies on meditation practices (41 intervention studies and 1 observational analytical study) have been conducted in musculoskeletal conditions including chronic pain, fibromyalgia, rheumatoid arthritis, and osteoarthritis. Respiratory conditions (e.g., asthma and chronic obstructive pulmonary disease) have been examined in 16 intervention studies. Twelve intervention studies in oncology have been conducted using different types of cancer populations, such as breast, prostate, skin and lymphoma. Endocrine diseases such as type II diabetes mellitus (DM) and obesity conditions have been examined in 11 intervention studies on meditation practices. Heterogeneous patient populations with a variety of medical conditions not specified have been examined in 11 intervention studies.

Gynecological conditions such as postmenopause, menopause, premenstrual syndrome, pregnancy, and infertility have been examined in 10 intervention studies. Populations with gastrointestinal disorders have been examined in three intervention studies. Three intervention studies have examined the effect of meditation practices in dermatological disorders, such as psoriasis, and on vestibular problems, such as tinnitus. Finally, patients with dental problems (one intervention study, one observational study), end-stage renal disease (one intervention study), and organ transplants (one intervention study) have been used as study populations for studies on meditation practices.

After excluding healthy populations, the distribution of conditions or disorders for which meditation practices have been examined was

1. hypertension (35 intervention studies and 2 observational analytical studies);
2. other cardiovascular diseases (24 intervention studies);
3. substance abuse disorders (18 intervention studies);
4. anxiety disorders (14 intervention studies);
5. cancer (12 intervention studies);
6. asthma (11 intervention studies);
7. chronic pain (10 intervention studies and 1 observational analytical study);
8. type II DM (10 intervention studies);
9. fibromyalgia (10 intervention studies); and
10. miscellaneous psychiatric conditions (six intervention studies and one observational analytical study).

Table G9 in Appendix G[*] provides a comparative summary of the number and study references by meditation practice, separated by the conditions and populations for which they have been examined.

Mantra meditation. Among the intervention studies on *TM*®, the majority (72 percent, 57/80) have been conducted in healthy populations (college and university students [24 studies], healthy volunteers from the community [19 studies], prison inmates [4 studies], elderly [3 studies], smokers [2 studies], and athletes [1 study]). The second largest group of TM® studies examined its effects on mental health disorders (nine studies) such as substance abuse (five studies), anxiety disorders (two studies), posttraumatic stress disorder (one study), and other miscellaneous psychiatric conditions (one study). Participants with circulatory or cardiovascular diseases such as hypertension (9 studies) and coronary artery disease (1 study) have been included in 10 studies on TM®. Other conditions such as asthma (two studies), chronic insomnia (one study), and a miscellaneous group of cancer patients (one study) have also been included in intervention studies on TM®.

The vast majority of observational analytical studies on TM® (98 percent, 148/151) have been conducted in healthy populations (healthy volunteers from the community [91 studies], college and university students [48 studies], prison inmates [3 studies], and workers [1 study]). Conditions such as pregnancy (one study), postmenopause (one study), and dental problems (e.g., periodontitis, one study) have been also examined.

Intervention studies on *RR* have included mainly healthy populations (31 studies), in addition to circulatory and cardiovascular conditions (hypertension [4 studies], other cardiovascular conditions [5 studies] including chronic heart failure, congestive heart failure, ischemic heart disease, premature ventricular contractions, and peripheral vascular disease), mental health disorders (substance abuse [2 studies], anxiety disorders [1 study], schizophrenia or antisocial personality disorders [1 study]), gynecological conditions (menopause [1 study], premenstrual syndrome [1 study]), and other clinical conditions such as irritable bowel syndrome (1 study), total knee replacement (1 study), skin cancer (1 study), and a group of patients with heterogeneous clinical conditions (1 study). The only observational analytical study on RR has been conducted in a population of hypertensive patients.

[*]Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Nineteen intervention studies on *mantra meditation techniques not further described* have been conducted with healthy populations. Other populations included people with mental health disorders (anxiety disorders [three studies], substance abuse [two studies], miscellaneous psychiatric conditions [one study]), hypertension (one study), and epilepsy (one study). The six observational analytical studies conducted on mantra techniques not further described have included healthy volunteers from the community.

Seven intervention studies on *CSM* have been conducted on healthy populations, three on mental disorders such as anxiety disorders (one study), schizophrenia (one study), and substance abuse (one study), and another study on chronic insomnia.

All the intervention and observational analytical studies on *Acem meditation*, *Ananda Marga*, *Cayce's meditation*, and *Rosary prayer* have been conducted with healthy populations.

Yoga. Among the intervention studies on Yoga, more than half (80/158) have been conducted with healthy populations (healthy volunteers from the community [34 studies], college and university students [26 studies], army and military personnel [7 studies], workers [5 studies], prison inmates [4 studies], and athletes [1 study]). The second largest group of conditions studied is constituted by circulatory and cardiovascular diseases (21 studies) such as hypertension (13 studies), and other cardiovascular conditions (8 studies). Studies on Yoga have also included participants with mental health disorders (16 studies) such as depression (7 studies), anxiety disorders (3 studies), substance abuse (3 studies), other miscellaneous psychiatric conditions (2 studies), and obsessive-compulsive disorders (1 study). Respiratory and pulmonary conditions such as asthma (nine studies), chronic airways obstruction, chronic bronchitis, pleural effusion, and pulmonary tuberculosis (one study each) have been also examined. Participants with musculoskeletal conditions such as chronic pain, rheumatoid arthritis (two studies each), carpal tunnel syndrome, chronic rheumatic diseases, fibromyalgia, hyperkyphosis, multiple sclerosis, osteoarthritis, and postpolio syndrome (one study each) have been included in intervention studies on Yoga. Other conditions examined in Yoga studies were gastrointestinal disorders (two studies), epilepsy, migraine, pregnancy, human immunodeficiency virus (HIV), lymphoma, chronic insomnia, tinnitus, and heterogeneous patient populations (one study each). All the observational analytic studies on Yoga (33 studies) have been conducted with healthy populations.

Mindfulness meditation. Among the 49 intervention studies on *MBSR*, 12 were conducted with healthy populations and 12 with populations with mental health disorders. Mental health disorders included anxiety disorders (three studies), mood disorders (two studies), substance abuse (two studies), binge eating disorders, burnout, personality disorders, miscellaneous psychiatric conditions, and stress-related conditions of parents of children with behavioral problems (one study each).

Participants with musculoskeletal conditions such as chronic pain (four studies) and fibromyalgia (two studies) have been also included. Cancer patients have been included in four intervention studies on MBSR. Other conditions such as psoriasis (two studies), cardiovascular diseases (two studies), traumatic brain injuries (two studies), obesity, HIV, and organ transplantation (one study each) have also been included. No observational analytic studies on MBSR were identified.

Eleven intervention studies on *mindfulness meditation not further specified* have been conducted in healthy populations. Other populations included mental health disorders (binge eating disorders [two studies], anxiety disorders, psychosis, substance abuse [one study each]).

Musculoskeletal conditions such as fibromyalgia (three studies) and chronic pain (two studies), cardiovascular diseases, cancer (three studies each), psoriasis, infertility, and heterogeneous patient populations (one study each) have been included also. The majority of observational analytical studies on mindfulness meditation techniques not further specified (six studies) have been conducted in healthy populations, with only one observational study conducted in a clinical population (individuals with chronic pain).

The majority of intervention studies (73 percent) on *Zen Buddhist meditation* have been conducted on healthy participants (11 studies). Clinical conditions that have been studied in intervention studies include hypertension (two studies), coronary artery disease, and insomnia (one study each). All the observational analytical studies conducted on Zen Buddhist meditation (13 studies) have included healthy volunteers.

Three intervention studies on *MBCT* have included patients with a depressive disorder. Other populations that have been examined are individuals with fibromyalgia, stroke, tinnitus, and healthy workers (one study each). No observational studies on MBCT were identified.

Intervention studies on *Vipassana meditation* have involved healthy populations from the community and patients with migraine or tension headaches (one study each). The observational analytical studies conducted on Vipassana meditation (four studies) have employed healthy populations from the community (two studies), college and university students, and elderly individuals (one study each).

Tai Chi. Intervention studies on Tai Chi have mainly assessed healthy populations (38 studies), particularly the elderly (25 studies). Clinical conditions examined in intervention studies of Tai Chi include musculoskeletal conditions such as rheumatoid arthritis (four studies), osteoarthritis (three studies), chronic pain (two studies), balance disorders, fibromyalgia, multiple sclerosis, and osteoporosis (one study each). Circulatory and cardiovascular conditions have been examined in four studies. Other populations examined in studies on Tai Chi are menopause, postmenopause, depression, miscellaneous psychiatric conditions, developmental disabilities, stroke, type II DM, HIV, breast cancer, end-stage renal disease, and vestibulopathy (one study each). The majority (91 percent, 20/22) of the observational analytical studies conducted in Tai Chi have examined groups of healthy, elderly individuals or other healthy individuals from the community. Two observational studies have been conducted in groups of postmenopausal women.

Qi Gong. Intervention studies on Qi Gong have examined populations of healthy participants (seven studies), patients with circulatory and cardiovascular disorders (hypertension [four studies], coronary artery disease [one study]), musculoskeletal conditions (fibromyalgia [two studies], muscular dystrophy and regional pain syndrome [one study each]), type II DM, substance abuse, miscellaneous medical conditions, migraine, and chronic obstructive pulmonary disease (COPD) (one study each). Almost all the observational analytical Qi Gong studies (14/15) were conducted with healthy populations; one was conducted with hypertensives.

Meditation practices (ND). Among the 19 intervention studies that failed to describe the meditation practice under study, 12 examined healthy college and university students (nine studies), workers (2 studies), and healthy volunteers from the community (one study). Intervention studies on clinical conditions included patients with hypertension, dental problems, and insomnia (one study each). Two observational studies included respectively, healthy college and university students and individuals with miscellaneous psychiatric conditions.

Miscellaneous meditation practices. Five of the six intervention studies that combined different meditation practices were conducted in healthy populations (three studies), miscellaneous psychiatric conditions, and heterogeneous populations of patients (one study each). One intervention study was conducted in patients with breast cancer. All five observational studies on miscellaneous meditation practices examined healthy populations.

Tables 22 and 23 summarize the diseases, conditions, and populations for which meditation practices have been studied in intervention and observational analytical studies.

Table 22. Intervention studies conducted on meditation practices by populations examined*

Category	Population	Mantra meditation (N)	Mindfulness meditation (N)	Meditation practices (ND) (N)	Miscellaneous meditation practices (N)	Qi Gong (N)	Tai Chi (N)	Yoga (N)	Total (N)	Studies per category (N)
Circulatory and cardiovascular	Hypertension	14*	2	1	...	4	1	13	33	59
	Other cardiovascular diseases	6	6	...	...	1	3	8	24	
Dental	Dental problems (NS)	...	...	1	...	...	...	...	1	1
Dermatology	Psoriasis	...	3	...	...	...	...	...	3	3
Endocrine	Obesity	...	1	...	...	...	...	...	1	11
	Type II diabetes mellitus	...	...	...	...	2	1	7	10	
Gastrointestinal	Gastrointestinal disorders	...	...	...	...	...	...	1	1	3
	Irritable bowel syndrome	1	...	...	...	...	...	1	2	
Gynecology	Infertility	...	1	...	...	...	...	...	1	6
	Menopause	1	...	...	...	...	1	...	2	
	Postmenopause	...	...	...	...	...	1	...	1	
	Pregnancy	...	...	...	...	...	...	1	1	
	Premenstrual syndrome	1	...	...	...	...	...	...	1	
Healthy	College and university students	56	23	9	2	2	4	27	124	296
	Elderly	3	...	...	...	1	25	5	34	
	Healthy volunteers	36	6	1	1	4	8	34	90	
	Army and military	1	...	...	...	...	...	7	8	

*Only conditions for which studies were available

COPD = chronic obstructive pulmonary disease; HIV = human immunodeficiency virus; ND = not described; NS = not specified

Table 22. Intervention studies conducted on meditation practices by populations examined (continued)

Category	Population	Mantra meditation (N)	Mindfulness meditation (N)	Meditation practices (ND) (N)	Miscellaneous meditation practices (N)	Qi Gong (N)	Tai Chi (N)	Yoga (N)	Total (N)	Studies per category (N)
Healthy (continued)	Prison inmates	5	...	...	...	...	...	2	7	
	Workers	12	5	2	...	...	1	5	25	
	Athletes	4	1	...	...	...	...	1	6	
	Smokers	2	1	...	...	...	...	...	3	
Immunologic	HIV	...	1	...	...	...	1	1	3	3
Sleep disorders	Insomnia	...	1	1	...	...	...	...	2	5
	Chronic insomnia	2	...	...	...	...	...	1	3	
Mental health disorders	Anger management	...	...	1	...	...	...	...	1	65
	Anxiety disorders	7	4	...	...	...	...	3	14	
	Binge eating disorder	...	3	...	...	...	...	...	3	
	Burnout	...	1	...	...	...	...	...	1	
	Depression	...	3	...	...	...	1	7	11	
	Miscellaneous psychiatric conditions	2	1	...	1	...	1	1	6	
	Mood disorders	...	2	1	...	...	...	...	3	
	Neurosis	...	...	...	...	...	...	1	1	
	Obsessive-compulsive disorder	...	...	...	...	...	...	1	1	
	Parents of children with behavior problems	...	1	...	...	...	...	...	1	
	Personality disorders	...	1	...	...	...	...	...	1	

Table 22. Intervention studies conducted on meditation practices by populations examined (continued)

Category	Population	Mantra meditation (N)	Mindfulness meditation (N)	Meditation practices (ND) (N)	Miscellaneous meditation practices (N)	Qi Gong (N)	Tai Chi (N)	Yoga (N)	Total (N)	Studies per category (N)
Mental health disorders (continued)	Postraumatic stress disorders	1	...	...	...	...	...	...	1	
	Psychosis	...	1	...	...	...	...	...	1	
	Schizophrenia	1	...	...	...	...	...	...	1	
	Schizophrenia and antisocial personality disorders	1	...	...	...	...	...	...	1	
	Substance abuse	9	3	2	...	1	...	3	18	
Miscellaneous medical conditions	Heterogeneous patient population	1	6	...	1	1	...	1	10	11
	Chronic fatigue	...	1	...	...	...	...	...	1	
Musculo-skeletal	Balance disorders	...	...	...	...	...	1	...	1	41
	Carpal tunnel syndrome	...	...	...	...		...	1	1	
	Multiple sclerosis	...	...	...	...	...	1	1	2	
	Muscular dystrophy	...	...	...	...	1	...	...	1	
	Chronic pain	...	6	...	...	2	2	10		
	Chronic rheumatic diseases	...	...	...	...	...	...	1	1	
	Fibromyalgia	...	6	...	...	2	1	1	10	
	Regional pain syndrome	...	...	...	...	1	...	...	1	
	Rheumatoid arthritis	...	...	...	...	...	4	2	6	

Table 22. Intervention studies conducted on meditation practices by populations examined (continued)

Category	Population	Mantra meditation (N)	Mindfulness meditation (N)	Meditation practices (ND) (N)	Miscellaneous meditation practices (N)	Qi Gong (N)	Tai Chi (N)	Yoga (N)	Total (N)	Studies per category (N)
Musculo-skeletal (continued)	Hyperkyphosis	...	...	...	...	...	-	1	1	
	Osteoarthritis	...	...	...	...	...	3	1	4	
	Osteoporosis	...	...	...	...	...	1	...	1	
	Postpolio syndrome	...	...	...	...	...	...	1	1	
	Total hip and knee replacement	1	...	...	...	...	...	...	1	
Neurological	Developmental disabilities	...	...	...	...	...	1	...	1	10
	Epilepsy	1	...	...	...	...	...	1	2	
	Migraine and tension headaches	...	1	...	...	1	...	1	3	
	Stroke	...	1	...	...	...	1	...	2	
	Traumatic brain injuries	...	2	...	...	...	...	...	2	
Oncology	Cancer	2	7	...	1	...	1	1	12	12
Organ transplant	Organ transplantation	...	1	...	...	...	...	...	1	1
Renal	End-stage renal disease	...	...	...	...	...	1	...	1	1
Respiratory and pulmonary	Asthma	2	...	...	...	...	...	9	11	16
	COPD	...	...	...	...	1	...	...	1	
	Chronic airways obstruction	...	...	...	...	...	...	1	1	
	Chronic bronchitis	...	...	...	...	...	...	1	1	
	Pleural effusion	...	...	...	...	...	...	1	1	

Table 22. Intervention studies conducted on meditation practices by populations examined (continued)

Category	Population	Mantra meditation (N)	Mindfulness meditation (N)	Meditation practices (ND) (N)	Miscellaneous meditation practices (N)	Qi Gong (N)	Tai Chi (N)	Yoga (N)	Total (N)	Studies per category (N)
Respiratory and pulmonary (continued)	Pulmonary tuberculosis	...	...	...	...	...	...	1	1	
Vestibular	Tinnitus	...	1	...	...	...	...	1	2	3
	Vestibulopathy	...	...	...	...	...	1	...	1	
Total		172	103	19	6	22	66	159	548	547

Table 23. Observational analytical studies conducted on meditation practices by populations examined*

Category	Population	Mantra meditation (N)	Mindfulness meditation (N)	Meditation practices (ND) (N)	Miscellaneous meditation practices (N)	Qi Gong (N)	Tai Chi (N)	Yoga (N)	Total (N)	Studies per category (N)
Circulatory and cardiovascu-lar	Hypertension	1	...	...	...	1	...	...	2	2
Dental	Periodontitis	1	...	...	...	...	...	...	1	1
Gynecology	Postmenopause	1	...	...	...	...	2	...	3	4
	Pregnancy	1	...	...	...	...	...	...	1	
Healthy	College and university students	48	6	1	1	2	...	7	65	257
	Elderly	5	1	...	...	1	18	1	26	
	Healthy volunteers	104	16	...	4	11	2	23	160	
	Prison inmates	3	...	...	...	...	...	...	3	
	Workers	1	...	...	...	...	...	2	3	
Mental health disorders	Miscellaneous psychiatric conditions	...	...	1	...	...	...	...	1	1
Musculo-skeletal	Chronic pain	...	1	...	...	...	...	...	1	1
Total		165	24	2	5	15	22	33	266	266

*Only conditions for which studies were available
ND = not described; NS = not specified

Outcome Measures Used in Studies on Meditation Practices

In total, 3,665 outcome measures were reported in 813 studies on meditation practices. The median number of outcomes reported per study was four (IQR, 2 to 6). Table 24 displays the type of outcome measures that have been examined in studies on meditation practices.

Table 24. Type of outcome measures examined in studies on meditation practices

Domain	Outcomes	No. measures (%)	No. per domain
Physiological	Cardiovascular	496 (13.51)	1,474
	Pulmonary and respiratory	251 (6.85)	
	Nutritional biochemistry and metabolism	235 (6.41)	
	Endocrine and hormonal	125 (3.41)	
	Brain and nervous system	112 (3.06)	
	Electrodermal responses	72 (1.96)	
	Muscular	46 (1.26)	
	Lymphatic and immunological	45 (1.23)	
	Blood	28 (0.76)	
	Thermoregulatory	22 (0.60)	
	Skeletal	14 (0.38)	
	Ocular	13 (0.35)	
	Sensory	8 (0.22)	
	Renal and excretory	7 (0.19)	
	Gastric	1 (0.03)	
Psychosocial	Psychiatric and psychological symptoms	645 (15.6)	1,204
	Personality	313 (8.54)	
	Positive psychology outcomes	108 (2.95)	
	Social and interpersonal relationships	50 (1.36)	
	Health-related quality of life	42 (1.15)	
	Activities of daily living and events impact	26 (0.71)	
	Other behavioral	20 (0.55)	
Clinical	Physical functionality	252 (6.88)	698
	Clinical events and symptoms improvement	154 (4.20)	
	Nutritional status, body composition or weight	74 (2.02)	
	Health status or well-being	70 (1.91)	
	Sleep	55 (1.50)	
	Pain and pain-related behavior	54 (1.47)	
	Falls occurrence and related behaviors	17 (0.46)	
	Adherence	12 (0.33)	
	Mortality	8 (0.22)	
	Longevity	2 (0.05)	

Table 24. Type of outcome measures examined in studies on meditation practices (continued)

Domain	Outcomes	No. measures (%)	No. per domain
Cognitive and neuro-psychological	Sensory perceptual and motor functions	103 (2.81)	239
	Reasoning and executive functions	40 (1.09)	
	General functions	37 (1.01)	
	Memory	24 (0.65)	
	Attention	22 (0.60)	
	Language	13 (0.35)	
Healthcare utilization	Medication use	30 (0.82)	50
	Healthcare utilization and economic outcomes	20 (0.55)	
Total		3,665	3,665

The most frequently studied outcomes were those of physiological functions (1,474 measures), followed by psychosocial outcomes (1,204 measures), outcomes related to clinical events and health status (698 measures), cognitive and neuropsychological functions (239 measures), and healthcare utilization (50 outcomes).

Studies on mantra meditation techniques reported the largest number of outcome measures (1,306 measures), followed by studies on Yoga (989 measures), mindfulness meditation techniques (567 measures), Tai Chi (489 measures), and Qi Gong (197 measures). Studies that did not describe the meditation practice under study reported 76 measures and studies that combined practices reported 41 measures.

Table 25 provides a summary of the type and number of outcome measures examined by meditation practice.

Physiological outcomes. *Cardiovascular* measures (495 measures) were the most frequently examined variables among the physiological outcomes. They included variables such as changes in systolic and diastolic blood pressure, heart rate, oxygen consumption, and electrocardiogram patterns. Other physiological measures frequently reported included *pulmonary and respiratory* outcomes (251 measures) such as respiratory rate, lung function testing measures (e.g., forced expiratory volume [FEV1], forced vital capacity [FVC], peak expiratory flow rate [PEFR]), and carbon monoxide levels). *Nutritional biochemistry and metabolism* outcomes (235 measures) included biochemical and metabolic processes measures that act as markers of certain diseases or conditions. These measures included serum levels of cholesterol, tryglicerides, glucose, lactate, potassium, calcium, sodium, and lipid profile.

Endocrine and hormonal outcomes (125 measures) described changes in substances secreted by the endocrine system to regulate the activity of the organs. They included measures of cortisol levels, neurohormones, catecholamines, endorphines, adrenaline, and aldosterone. *Brain and nervous system* measures (112 measures) included electroencephalogram (EEG) profile, P300 latencies, and neurotransmitter levels. *Electrodermal responses*, also known as galvanic skin responses, skin conductance, and skin resistance (72 measures), included measures of the ability of the skin to conduct an electrical current as a sympathetic reaction to emotional arousal and stress. *Muscular* physiology (46 measures), as a proxy for emotional arousal, was examined for variables such as muscle tension and relaxation, frontal electromyographic activity, muscle voltage, and reflex function, among others. Outcomes related to the physiological functioning of the *immune* system (45 measures) included immunoglobulin (IgA, IgG, and IgM) concentrations, leukocytes, lymphocytes, monocytes, and neutrophil levels in general, natural killer cell activity, white blood cell count, and number of monoclonal antibodies. There were 28 outcomes related to *blood* products and hemodynamic parameters, 22 on *thermoregulatory* functions such as skin or body temperature, and 14 measures related to the *skeletal* system, for example, bone mineral density. Other physiological outcomes less frequently reported included *ocular* (e.g., intraocular pressure, pupillary dilatation) (13 measures), *sensory*, for example, auditory thresholds (8 measures), *renal* function tests (7 measures), and *gastric* measures, for example, gastric motility (1 measure).

Table 25. Number of outcome measures examined by meditation practice

Category	Population	Mantra meditation (N)	Mindfulness meditation (N)	Meditation practice (ND) (N)	Miscellaneous meditation practices (N)	Qi Gong (N)	Tai Chi (N)	Yoga (N)	Total (N)	Measures per category (N)
Physiological	Cardiovascular	196	25	9	...	27	87	151	495	1,474
	Pulmonary and respiratory	83	14	1	...	14	33	106	251	
	Nutritional biochemistry and metabolism	76	3	2	2	22	20	110	235	
	Endocrine and hormonal	49	10	2	...	15	7	42	125	
	Brain and nervous system	73	13	...	...	7	...	19	112	
	Electrodermal responses	53	8	1	...	...	...	10	72	
	Muscular	30	2	2	...	...	6	6	46	
	Lymphatic and immunological	5	9	...	...	29	1	1	45	
	Blood	12	1	1	...	3	1	10	28	
	Thermoregulatory	10	1	1	...	1	2	7	22	
	Skeletal	...	...	...	...	...	12	2	14	
	Ocular	6	...	...	...	...	...	7	13	
	Sensory	3	...	...	...	...	...	5	8	
	Renal and excretory	...	...	2	...	3	1	1	7	
	Gastric	...	...	...	...	...	...	1	1	

ND = not described

Table 25. Number of outcome measures examined by meditation practice (continued)

Category	Population	Mantra meditation (N)	Mindfulness meditation (N)	Meditation practice (ND) (N)	Miscellaneous meditation practices (N)	Qi Gong (N)	Tai Chi (N)	Yoga (N)	Total (N)	Measures per category (N)
Psychosocial	Psychiatric and psychological symptoms	231	183	20	13	25	33	140	645	1,204
	Personality	146	66	12	6	8	14	61	313	
	Positive psychology outcomes	37	37	4	5	...	4	21	108	
	Social and interpersonal relationships	26	14	...	...	...	3	7	50	
	Health-related quality of life	3	12	2	1	4	10	10	42	
	Activities of daily living and events impact	8	8	...	1	1	5	3	26	
	Other behavioral	7	3	1	3	...	1	5	20	
Clinical	Physical functionality	12	7	1	1	8	165	58	252	698
	Clinical events and symptoms improvement	33	31	1	3	8	17	61	154	
	Nutritional status, body composition and weight	22	10	...	...	7	8	27	74	
	Health status and well-being	11	23	1	2	3	13	17	70	
	Sleep	25	14	2	...	1	2	11	55	
	Pain and pain-related behavior	6	20	...	...	6	11	11	54	
	Falls occurrence and related behavior	...	...	...	...	1	16	-	17	
	Adherence	4	3	...	...	...	3	2	12	
	Mortality	5	...	...	...	2	...	1	8	
	Longevity	2	...	...	...	...	...	...	2	

Table 25. Number of outcome measures examined by meditation practice (continued)

Category	Population	Mantra meditation (N)	Mindfulness meditation (N)	Meditation practice (ND) (N)	Miscellaneous meditation practices (N)	Qi Gong (N)	Tai Chi (N)	Yoga (N)	Total (N)	Measures per category (N)
Cognitive and neuropsychological	Sensory perceptual and motor functions	48	18	3	2	...	8	24	103	239
	Reasoning and executive functions	21	11	5	1	...	...	2	40	
	General functions	17	5	1	1	...	4	9	37	
	Memory	14	3	2	...	...	...	5	24	
	Attention	10	5	...	...	...	...	7	22	
	Language	5	1	...	...	...	...	7	13	
Healthcare utilization	Medication use	4	3	...	...	2	2	19	30	50
	Healthcare utilization and economic outcomes	13	4	...	...	...	...	3	20	
Total		1321	567	76	41	197	489	989	3680	3680

Psychosocial outcomes. The most studied psychosocial outcomes were those measuring *psychiatric and psychological symptoms* (645 measures) of anxiety, depression, stress, mood states, irritability and anger expression, and abuse of psychoactive or other substances causing psychological dependence. Measures of *personality* (both normal and abnormal) were reported for 313 outcomes. These studies reported data on either general characteristics of the personality (e.g., personality and psychological profiles, ego strength, and coping styles) or particular traits or characteristics of the individual psychological functioning (e.g., locus of control, neuroticism, psychoticism, extraversion, self-actualization, self-esteem, and hostility traits). *Positive psychology outcomes* (measures of processes that contribute to flourishing or optimal functioning of individuals (e.g., empathy, assertive behavior, happiness, spirituality, autonomy) were reported in 108 outcomes). Outcomes related to *social and interpersonal relationships* such as marital adjustment, level of interpersonal conflicts, social adjustment, and social functioning, were examined in 50 measures. *Health-related quality of life* measures were reported for 42 outcomes. Other psychosocial outcomes included *activities of daily living* (26 measures), and other miscellaneous and nonspecific behavioral measures not further classified, such as "level of relaxation" and "hypnotic response."

Clinical outcomes. Measures examining physical functions such as balance, strength, flexibility, mobility, and postural stability were the most frequently reported types of clinical outcomes (252 measures). They were followed by measures of discrete clinical events, or indicators of symptom improvement that were particular to the conditions under study, such as change in fibromyalgia symptoms, number of asthma episodes, and angina pectoris symptoms (154 measures). Outcomes related to the *nutritional status* or body composition of individuals (74 measures) included body weight, body mass index, and diet and nutritional patterns. There were 70 outcomes related to *general health status and well-being*, 55 outcomes for *sleep* characteristics, and 54 for pain-related symptoms. Seventeen outcomes reported on the frequency of falls or falls-related behaviors. Other clinical measures included *adherence* (12 measures), *mortality* (8 measures), and *longevity* (2 measures).

Cognitive and neuropsychological measures. Measures related to *sensory perception and motor functions* (103 measures) were the most frequently examined cognitive and neuropsychological outcomes. These measures included psychomotor performance, perceptual motor skills, field independence, absorption, autonomic arousal, and visual-spatial ability. Other cognitive and neuropsychological measures less frequently examined included *reasoning and executive functions* (40 measures) (e.g., cognitive flexibility, logical reasoning, thought categorization, and associate learning). *General cognitive* outcomes (37 measures) included global measures of intelligence, cognitive status, and neuropsychological functioning. *Memory* functions (e.g., short- and long-term, verbal and visual, declarative and procedural) were reported by 24 measures. Finally, *language* (e.g., verbal fluency, vocabulary, language comprehension, reading skills) and *attention* functions (e.g., concentration, sustained focusing capacity) were each reported by seven measures.

Healthcare utilization: A number of outcomes addressed factors related to the use of healthcare resources, such as medication use (30 measures), length of hospital stay, medical utilization rates, number of sick leaves, and payments to the healthcare system (20 measures).

When the outcome measures were analyzed by the type of meditation practice under study, we found that the 10 most frequently reported outcome measures in mantra meditation studies were

1. psychiatric and psychological symptoms (231 measures);
2. physiological cardiovascular outcomes (196 measures);
3. personality outcomes (146 measures);
4. physiological pulmonary and respiratory outcomes (83 measures);
5. physiological nutrition, biochemical and metabolic outcomes (76 measures);
6. physiological brain and nervous system outcomes (73 measures);
7. physiological electrodermal responses (53 measures);
8. physiological endocrine and hormonal outcomes (49 measures);
9. sensory perceptual and motor neuropsychological functions (48 measures); and
10. positive psychology outcomes (37 measures).

There are no studies on mantra meditation practices that have reported skeletal, renal and excretory, or gastric physiology outcomes or the occurrence of falls or fall-related behaviors.

The 10 most frequently reported outcome measures in studies on Yoga were

1. physiological cardiovascular outcomes (151 measures);
2. psychiatric and psychological symptoms (140 measures);
3. physiological nutrition, biochemical and metabolic outcomes (110 measures);
4. physiological pulmonary and respiratory outcomes (106 measures);
5. personality outcomes (61 measures);
6. clinical events and symptom improvement (61 measures);
7. physical functionality outcomes (58 measures);
8. physiological endocrine and hormonal outcomes (42 measures);
9. outcomes of nutritional status and body composition (27 measures); and
10. sensory perceptual and motor neuropsychological functions (24 measures).

No studies on Yoga reported on the occurrence of falls or fall-related behaviors, or on longevity of study participants.

The 10 most frequently reported outcome measures in studies on Tai Chi were

1. physical functionality (165 measures);
2. physiological cardiovascular outcomes (87 measures);
3. physiological pulmonary and respiratory outcomes (33 measures);
4. psychiatric and psychological symptoms (33 measures);
5. physiological nutrition, biochemical and metabolic outcomes (20 measures);
6. clinical events and symptom improvement (17 measures);
7. falls and fall-related behavior (16 measures);
8. personality measures (14 measures);
9. measures of health status and well-being (13 measures); and
10. physiological skeletal outcomes (12 measures).

There are no studies on Tai Chi that reported physiological outcomes related to the brain and central nervous system, ocular, sensory, or gastrointestinal systems, or electrodermal response. Studies on Tai Chi have not examined outcomes related to mortality, longevity, healthcare utilization, or cognitive and neuropsychological functions such as reasoning, memory, attention, and language.

The 10 most frequently outcome measures in studies on mindfulness meditation practices were

1. psychiatric and psychological symptoms (183 measures);
2. personality measures (66 measures);
3. positive psychology outcomes (37 measures);
4. clinical events and symptom improvement (31 measures);
5. physiological cardiovascular outcomes (25 measures);
6. measures of health status and well-being (23 measures);
7. measures of pain and pain-related behavior (20 measures);
8. sensory perceptual and motor neuropsychological functions (18 measures);
9. physiological pulmonary and respiratory outcomes (14 measures); and
10. social and interpersonal relationships measures (14 measures).

No studies on mindfulness meditation practices have reported outcomes of longevity, physiology of ocular, sensory, gastric, skeletal or renal systems, mortality, or the incidence of falls.

The 10 most frequently reported outcome measures in studies on Qi Gong were

1. physiological lymphatic and immunological outcomes (29 measures);
2. physiological cardiovascular outcomes (27 measures);
3. psychiatric and psychological symptoms (25 measures);
4. physiological nutrition, biochemical and metabolic outcomes (22 measures);
5. physiological endocrine and hormonal outcomes (15 measures);
6. physiological pulmonary and respiratory outcomes (14 measures);
7. personality measures (8 measures);
8. clinical events and symptom improvement (8 measures);
9. physical function (8 measures); and
10. physiological brain and nervous system outcomes (8 measures).

There are no studies on Qi Gong that reported physiological outcomes related to the muscular, skeletal, ocular, sensory, and gastric systems or on electrodermal response. Other outcomes that have not been examined in studies on Qi Gong include positive psychology, interpersonal and social relationships, and cognitive functions such as memory, attention, language, and reasoning and executive functions.

The 10 most studied outcome measures examined in studies that did not describe the meditation practice under study were

1. psychiatric and psychological symptoms (20 measures);
2. personality measures (20 measures);
3. physiological cardiovascular outcomes (9 measures);
4. reasoning and executive neuropsychological functions (5 measures);
5. positive psychology outcomes (4 measures);
6. sensory perceptual and motor neuropsychological functions (3 measures);
7. memory (3 measures);
8. muscular physiology (2 measures);

9. physiological nutrition, biochemical and metabolic outcomes (2 measures); and
10. physiological endocrine and hormonal outcomes (2 measures).

Finally, the most studied outcome measures in studies that combined miscellaneous approaches to the meditation practice were

1. psychiatric and psychological symptoms (13 measures);
2. personality measures (6 measures); and
3. positive psychology outcomes (5 measures).

Summary of the Results

General remarks. Evidence regarding the state of research on the therapeutic use of meditation was provided in 813 studies. Half of the studies on meditation practices were published after 1994. Most of the studies have been published as journal articles, and have been conducted in North America. More than half of the studies have examined meditation practices in intervention studies. The majority of the intervention studies on meditation practices are RCTs, followed by before-and-after studies, and NRCTs. A lesser proportion of studies have used observational analytical designs, the majority being cohort studies, and compared groups of meditators versus nonmeditators or compared different groups of meditators.

Methodological quality of the included studies. Overall, the methodological quality of both intervention and observational analytical studies on meditation practices is poor. A small proportion of RCTs reported adequately on the methods of randomization, blinding, description of withdrawals, and concealment of the sequence of allocation to treatment. Half of the RCTs explicitly reported the source of funding, as did a smaller proportion of NRCTs and before-and-after studies. The observational analytical studies that have been conducted on meditation practices are prone to biases affecting the representativeness of the study and comparison groups, the ascertainment of both exposure and outcome and, in the case of longitudinal studies (i.e., cohort studies), the integrity of the followup period. Compared to the cohort studies, the cross-sectional studies have less prominent methodological weaknesses. The only methodological aspect that did not appear to be severely jeopardized in the observational studies was the methods used to control for confounders in the design or analysis. More than half of observational studies have attempted to control for confounding either in the design or the analysis of the results.

Meditation practices examined in intervention and observational analytical studies. The category of meditation practices that has been most frequently studied in the scientific literature is mantra meditation. This category includes a group of meditation techniques that, despite differences in principles of practice and theoretical grounds, all have a mantra as an important component of their practice. Both intervention and observational analytical studies on TM® dominate the literature on mantra meditation techniques, followed by studies on RR. Other mantra techniques such as CSM, Acem meditation, Ananda Marga, concentrative prayer, and Cayce’s meditation have been examined less frequently.

The second category of meditation practices most frequently examined is Yoga. This category includes a heterogeneous group of practices rooted in yogic traditions such as Hatha, Kundalini, and Sahaja yoga. Mindfulness meditation is the third most studied group of practices.

Within this category, MBSR and Zen Buddhist meditation have been most frequently examined. The practice of Tai Chi is the fourth most frequently examined practice, followed by Qi Gong. Finally, less than five percent of the studies on meditation practices did not explicitly describe the practice under study or have combined different approaches to meditation in a single intervention without describing the individual components of the intervention.

Control groups. The number of control groups per study ranged from one to four. Among the six hundred and sixty-eight studies that used control groups, the majority of them utilized an active concurrent control for their comparisons. Among the RCTs and NRCTs, the practice of exercise and other physical activities constituted the most frequent active comparator followed by conditions involving states of rest and relaxation, educational activities, and PMR. Other active control groups included cognitive behavioral techniques, pharmacological interventions, psychotherapy, BF techniques, reading, hypnosis, therapeutic massage, and acupuncture. Almost half of the RCTs and NRCTs included comparison groups consisting of participants assigned to waiting lists or participants that did not receive any intervention. A lower proportion of RCTs and NRCTs compared different meditation practices against each other, different doses of the practice, or modified formats of similar techniques.

The vast majority of observational analytical studies used comparison groups consisting of individuals that had not been exposed to any type of meditation practice. A smaller proportion of observational analytical studies compared groups of individuals that have been actively exposed to different meditation practices.

Diseases, conditions, and populations examined in studies on meditation practices. The vast majority of studies on meditation practices have been conducted in healthy populations. The three most studied clinical conditions are hypertension, other cardiovascular diseases, and substance abuse. Other diseases that have been frequently examined include anxiety disorders, cancer, asthma, chronic pain, type II DM, fibromyalgia, and a variety of psychiatric conditions studied altogether. Studies on hypertension have been conducted mainly on mantra meditation and Yoga. Studies on other cardiovascular diseases have been conducted using Yoga, mindfulness meditation techniques, and mantra meditation. Studies on substance abuse have been conducted mainly on mantra meditation.

Outcome measures examined in studies on meditation practices. Studies on meditation practices tend to report a median number of four outcomes per study. The most frequently studied outcomes were those of physiological functions, followed by psychosocial outcomes, outcomes related to clinical events and health status, cognitive and neuropsychological functions, and healthcare utilization outcomes. Cardiovascular measures were the most frequently examined variables among the physiological outcomes. The most studied psychosocial outcomes were measures of psychiatric and psychological symptoms (e.g., anxiety and depression). Other psychosocial outcomes frequently reported include personality measures, positive psychology outcomes, and others related to social relationships, quality of life, and activities of daily living. Outcomes related to clinical events focused on measures of physical functionality, and the incidence of discrete clinical events. Among the cognitive and neuropsychological outcomes, measures of sensory perceptual and motor functions, and reasoning and executive functions were frequently examined. Finally, measures reporting healthcare utilization were uncommon.

Topic III. Evidence on the Efficacy and Effectiveness of Meditation Practices

The three most studied diseases identified in topic II were hypertension, cardiovascular diseases, and substance abuse disorders. Sixty-five RCTs and NRCTs (27 on hypertension, 21 on cardiovascular diseases, and 17 on substance abuse disorders) were included in the review on the efficacy and effectiveness of meditation practices. All qualifying studies are presented in summary tables in the appropriate sections. Details regarding these studies are available in Appendix H.*

Hypertension

Description of the Included Studies

Twenty-seven trials (24 RCTs[185,203-225] and 3 NRCTs[226-228]) were identified that evaluated the effects of meditation practices in hypertensive individuals (see Appendix H*). The included trials evaluated eight meditation practices aimed to ameliorate a variety of outcomes associated with hypertension. The group of studies comprised eight trials on yoga,[185,204,212,,216,,217,,219,,224,226] five trials on TM®,[205,206,210,220,221,222] four trials on RR,[208,209,218,228] four trials on Qi Gong,[207,211,213,214] two trials on Zen Buddhist meditation,[225,227] one trial on a technique modeled after TM®,[222] one trial on Tai Chi,[223] one trial on a mantra technique not further described,[203] and one trial on a meditation practice that did not specify the technique.[215]

The trials were published between 1975 and 2005 (median year of publication, 1995; IQR, 1982 to 2003). Twenty-four of these trials have been published in journals[185,203,204,206-209,211-214,216-228] while three[205,210,215] were identified from the gray literature. Nine trials[205,206,208-210,220,221,227,228] were conducted in the United States, four[204,212,217,226] in India, three[185,218,219] in the United Kingdom, two[211,225] in China, two[213,214] in South Korea, and one each in Germany,[215] Hong Kong,[207] The Netherlands,[224] New Zealand,[222] Russia,[203] Taiwan,[223] and Thailand.[216] The trials contained a total of 1,940 participants. The median sample size was 65 participants per study (IQR, 23 to 392; data from 19 trials). Seven[203,205,206,218,220,221,225] out of 19 trials had study sample sizes greater than 100 participants. The mean age of participants was 50.7 ± 9.6 years (range, 28 to 68 years; data from 20 trials). Two trials[203,227] were conducted in samples with an average age between 20 and 40 years. Sixteen trials[185,205-208,210,213,214,216,219,220,222-226] were conducted in samples with mean ages ranging from 41 to 60 years. Two trials[221,228] included study populations with mean ages of 61 years and above. Seven trials[204,209,211,212,215,217,218] did not report the age of participants.

When the trials that reported the gender of participants were combined (n = 23), 54 percent of the participants were male and 46 percent were female. Samples in four trials[203,204,211,226] were entirely male while none of the trials included entirely female samples. Four trials[185,209,212,217] failed to report the gender of participants. Six trials explicitly indicated the ethnicity of their

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

samples. Five of them[205,206,210,220,221] were conducted in African-American samples, whereas one trial[227] stated that only white participants took part in the study.

All the trials were conducted in patients with a diagnosis of essential hypertension. All trials except five[185,204,208,212,217] provided a definition of hypertension in their selection criteria. Half of the trials (n = 14)[203,207,209,210,213-216,218,220,221,225,226,228] included participants diagnosed with Stage 1 hypertension (mean systolic blood pressure [SBP] between 140 and 159 mm Hg and/or mean diastolic blood pressure [DBP] between 90 and 99 mm Hg) and with Stage 2 hypertension (mean SBP 160 mm Hg and above and/or mean DBP 100 mm Hg and above). One study[206] included participants with prehypertension (mean SBP between 120 and 139 mm Hg, and/or DBP between 80 and 89 mm Hg), Stage 1, and Stage 2 hypertension. Another study[205] was conducted in patients with prehypertension or with Stage 1 hypertension. Five trials[211,219,222,224,227] included only participants with Stage 2 hypertension, whereas one trial[223] included only participants with Stage 1 hypertension.

All 27 trials employed a parallel study design. The length of the trials varied from 8 days[204] to 1 year.[203,210,211,221,224] The median duration of the trials was 3 months (IQR, 2 to 6). Twelve studies[204,208,209,213-217,219,225,226,228] were short-term trials (less than 3 months), nine trials[185,205,207,212,218,220,222,223,227] had a duration from 3 to 6 months, and six trials[203,206,210,211,221,224] lasted longer than 6 months

The 27 trials comprised six comparisons between meditation practices and no intervention,[185,203,204,215,217,225] four comparisons between meditation practices and waiting list,[208,213,214,222] and one comparison[222] between meditation practices and placebo. There were 29 comparisons between meditation practices and active therapies other than no intervention, WL, or placebo. Because some trials had more than one comparison arm, the total number of comparisons exceeded the number of trials. Of the 29 active comparisons, the comparative treatments were health education (HE),[205,206,210,212,216,218,220,221,225] BF,[208,209,228] PMR,[204,220,221] rest or relaxation,[204,219,223] antihypertensive medication,[211,217] blood pressure checks,[225,227] exercise,[207] orthostatic tilt,[226] and meditation practice plus BF.[185] The median number of comparisons per study was one (IQR, 1 to 2).

Methodological Quality of the Included Studies

A summary of the methodological quality of the included trials is provided in Table 26. As a measure of methodological quality for included trials, the overall median Jadad score was 2/5 (IQR, 1 to 2). Only two trials[220,221] obtained 3 points and were considered of high quality. Twelve trials[185,203,206,207,210,214,216,218,219,222-224] obtained 2 points, nine trials[204,205,208,209,211,213,215,217,225] obtained 1 point, and four trials[212,226-228] did not obtain any points. All the trials except three[226-228] were described as randomized; however, the details of the description of randomization varied. The majority of trials (n = 19)[185,203-205,207-211,214-219,222-225] did not describe how the randomization was performed. Three trials[206,220,221] described an appropriate method to generate the sequence of randomization, whereas two trials[212,213] reported the use of inadequate approaches to sequence generation. None of the trials were described as double-blind. The adequacy of allocation concealment was unclear in all trials.

An intention-to-treat statistical analysis was specified in five trials.[203,206,207,220,221] Nineteen trials[185,203,205-207,209,210,212-214,216,218-225] reported the number of dropouts for the total study sample (mean dropout rate: 21 percent; range 3 to 57 percent). Seven trials[205,206,209,212,213,220,225] had a dropout rate of more than 20 percent. Withdrawals and dropouts per treatment group were clearly described in 14 trials.[185,203,207,210,213,214,216,218-224] On average, 14 percent of participants (range 0 to 26 percent) dropped out of the meditation groups. The mean dropout rate for the control groups was also 14 percent (range 4 to 25 percent; 16 control groups).

Fifteen trials[185,205-209,218-222,224,225,227,228] disclosed their source of funding. Nine trials [205,206,209,218-220,225,227,228] received funding from government sources, six studies[185,207,208,221,222,224] received funding from a private donor or foundation, and one[214] received internal funding.

Table 26. Methodological quality of trials of meditation practices for hypertension

Study, year	Meditation practice	Randomization		Double blinding		Description of withdrawals /dropouts	Overall Jadad score	Allocation concealment	Report of funding
		Stated	Method described	Stated	Method described				
Aivazyan TA, 1988[203]	Mantra meditation (NS) + relaxation techniques	Yes	Unclear	No	NA	Yes	2	Unclear	No
Broota A, 1995[204]	Yoga	Yes	Unclear	No	NA	No	1	Unclear	No
Calderon R Jr, 2000[205]	TM®	Yes	Unclear	No	NA	No	1	Unclear	Yes
Castillo-Richmond A, 2000[79,206]	TM®	Yes	Adequate	No	NA	No	2	Unclear	Yes
Cheung BMY, 2005[207]	Qi Gong	Yes	Unclear	No	NA	Yes	2	Unclear	Yes
Cohen J, 1983[208]	RR	Yes	Unclear	No	NA	No	1	Unclear	Yes
Hafner RJ, 1982[185]	Yoga + BF	Yes	Unclear	No	NA	Yes	2	Unclear	Yes
Hager JL, 1978[209]	RR	Yes	Unclear	No	NA	No	1	Unclear	Yes
Kondwani KA, 1998[210,229]	TM®	Yes	Unclear	No	NA	Yes	2	Unclear	No
Kuang AK, 1987[211]	Qi Gong + AHM	Yes	Unclear	No	NA	No	1	Unclear	No
Latha DR, 1991[212]	Yoga + BF (thermal)	Yes	Inadequate	No	NA	No	0	Unclear	No
Lee MS, 2003[214,230]	Qi Gong	Yes	Unclear	No	NA	Yes	2	Unclear	No
Lee MS, 2004[213,231]	Qi Gong	Yes	Inadequate	No	NA	Yes	1	Unclear	No
Manikonda P, 2005[215]	CMBT	Yes	Unclear	No	NA	No	1	Unclear	No

AHM = antihypertensive medication; AT = autogenic training; BE = breathing exercises; BF = biofeedback; CMBT = contemplative meditation and breathing technique; NA = not applicable; NS = not specified; PMR = progressive muscle relaxation; RR = Relaxation Response; TM® = Transcendental Meditation®

Table 26. Methodological quality of trials of meditation practices for hypertension (continued)

Study, year	Meditation practice	Randomization		Double blinding		Description of withdrawals /dropouts	Overall Jadad score	Allocation concealment	Report of funding
		Stated	Method described	Stated	Method described				
McCaffrey R, 2005[216]	Yoga	Yes	Unclear	No	NA	Yes	2	Unclear	No
Murugesan R, 2000[217]	Yoga	Yes	Unclear	No	NA	No	1	Unclear	No
Patel CH, 1985[218]	RR + BE + PMR	Yes	Unclear	No	NA	Yes	2	Unclear	Yes
Patel CH, 1975[219]	Yoga + BF	Yes	Unclear	No	NA	Yes	2	Unclear	Yes
Schneider RH, 1995[79,221,232]	TM®	Yes	Adequate	No	NA	Yes	3	Unclear	Yes
Schneider RH, 2005[220]	TM®	Yes	Adequate	No	NA	Yes	3	Unclear	Yes
Seer P, 1980[222]	SRELAX (technique modeled after TM®)	Yes	Unclear	No	NA	Yes	2	Unclear	Yes
Selvamurthy W, 1998[226]	Yoga	No	NA	No	NA	No	0	Unclear	No
Stone RA, 1976[227]	Zen Buddhist meditation	No	NA	No	NA	No	0	Unclear	Yes
Surwit RS, 1978[228]	RR	No	NA	No	NA	No	0	Unclear	Yes
Tsai JC, 2003[223]	Tai Chi	Yes	Unclear	No	NA	Yes	2	Unclear	No
van Montfrans GA, 1990[224]	Yoga + RR + PMR + AT	Yes	Unclear	No	NA	Yes	2	Unclear	Yes
Yen LL, 1996[225]	Zen Buddhist meditation + PMR	Yes	Unclear	No	NA	No	1	Unclear	Yes

Results of Direct Comparisons

Table 27 summarizes the meditation practices, comparison groups, and outcomes that were available for direct meta-analyses on the efficacy and effectiveness of meditation practices to treat hypertension. Direct meta-analyses were conducted when two or more studies assessed the same meditation practice, used similar comparison groups, and had usable data for common outcomes of interest. No single diagnostic criterion was chosen for categorizing study populations as hypertensive; rather, we included all studies conducted in hypertensive patients, as defined by the authors of the primary studies. Fifteen comparisons (14 studies) were not suitable for direct meta-analyses because no more than one study was available for statistical pooling: SRELAX (technique modeled after TM®) versus waiting list (WL),[222] SRELAX versus placebo,[222] RR versus HE,[218] RR versus WL,[208] Qi Gong versus antihypertensive medication (AHM),[211] Qi Gong versus exercise,[207] Tai Chi versus rest,[223] Yoga versus AHM,[217] Yoga versus orthostatic tilt,[226] Yoga versus progressive muscle relaxation (PMR),[204] Yoga versus relaxation,[224] Yoga versus Yoga plus BF,[185] Zen Buddhist meditation versus NT,[225] mantra meditation not specified versus NT,[203] and meditation practice not further specified versus NT.[215] Data from 16 studies were available for direct meta-analyses that involved eight comparisons: TM® versus HE, TM® versus PMR, RR versus BF, Qi Gong versus WL, Yoga versus NT, Yoga versus HE, Yoga versus rest, and Zen Buddhist meditation versus blood pressure checks. Outcomes of interest and comparisons for which data could be combined into a direct meta-analysis were

1. blood pressure: TM® versus HE, TM® versus PMR, RR versus BF, Qi Gong versus WL, Yoga versus NT, Yoga versus HE, Zen Buddhist meditation versus blood pressure checks;
2. body weight: TM® versus HE;
3. heart rate: TM® versus HE;
4. stress: TM® versus HE, Yoga versus HE;
5. anger: TM® versus HE;
6. self-efficacy: TM® versus HE;
7. total cholesterol (TC): TM® versus HE;
8. high-density lipoprotein cholesterol (HDL-C): TM® versus HE;
9. low-density lipoprotein cholesterol (LDL-C): TM® versus HE;
10. dietary intake (caloric intake, total fat intake, and sodium intake): TM® versus HE; and
11. physical activity: TM® versus HE.

Results from individual studies not included in a meta-analysis of clinical trials of meditation practices in hypertension are summarized in Table H1 in Appendix H.[*]

[*]Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Table 27. Summary of outcomes by meditation practice and by comparison group included in meta-analyses of the efficacy and effectiveness of meditation practices for hypertension

Intervention	Comparator	Outcome	No. studies	Meta-analysis	Outcomes for Meta-analysis
TM®	HE	TC, TG, LDL-C, HDL-C, BP changes, anger, stress, personal efficacy, diet, physical activity, pulse rate[205] cIMT, BP changes, weight, PR, TC, HDL-C, LDL-C, pulse pressure, smoking, exercise[206] LVMI, BP changes (DBP, SBP), weight, PR, PWT, LVIDD, LVIDS, IVST, E/A ratio, energy, stress impact, sleep, positive affect, sleep pattern, anxiety, depression, anger, self-efficacy, locus of control, diet, activity level, compliance[210] BP changes (DBP, SBP)[221] BP changes (DBP, SBP), change in AHM[220]	5	Yes	BP changes (DBP, SBP)[205,206,210,220,221] Total cholesterol[205,206] HDL-C [205,206] LDL-C [205,206] Body weight[205,206,210] Pulse rate[205,206,210] Stress[205,210] Diet (calories, fat, sodium)[205,210] Physical activity[205,210]
	PMR	BP changes (DBP, SBP), compliance[221] BP changes (DBP, SBP), change in AHM[220]	2	Yes	BP changes (DBP, SBP)[220,221]
	PLB	BP changes (DBP, SBP)[222]	1	No	NA
SRELAX (technique modeled after TM®)	WL	BP changes (DBP, SBP)[222]	1	No	NA
RR	HE	BP changes (DBP, SBP), TC, smoking, morbidity, mortality[218]	1	No	NA
	BFB	Attention (field independence, attention deployment, absorption), BP changes (DBP, SBP)[208] BP changes (DBP, SBP)[209] BP changes (DBP, SBP)[228]	3	Yes	BP changes (DBP, SBP)[208,209,228]
	WL	Attention (field independence, attention deployment, absorption), BP[208]	1	No	NA

AHM = antihypertensive medication; AI = alpha index; APO-A1 = apolipoprotein A1; BF = biofeedback; BMI = body mass index; BP = blood pressure; cIMT = carotid intima media thickness; CO = cardiac output; CPR = cold pressor response; Cr = creatinine; DBH = dopamine beta hydroxylase; DBP = diastolic blood pressure; E/A ratio = early filling divided by atrial constriction; EEG = electroencephalogram; EMG = electromyography; EPI = epinephrine; FEV1 forced expiratory volume in 1 second; FVC = forced vital capacity; GSR = galvanic skin response; HDL-C = high density lipoprotein cholesterol; HE = health education; HR = heart rate; HRQL = health-related quality of life; IVST = intraventricular septal thickness; K = potassium; LDL-C = low density lipoprotein cholesterol; LVIDD = left ventricular internal dimension at diastole; LVDIS = left ventricular internal dimension at systole; LVMI = left ventricular mass index; NA = not applicable; Na = sodium; NE = norepinephrine; NS = not specified; NT = no treatment; PLB = placebo; PMR = progressive muscle relaxation; PRA = plasma renin activity; PR = pulse rate; PWT = posterior wall thickness; RPP = rate pressure product; RR = Relaxation Response; SBP = systolic blood pressure; TC = total cholesterol; TG = triglycerides; TM® = Transcendental Meditation®; WL = waiting list

Table 27. Summary of outcomes by meditation practice and by comparison group included in meta-analyses of the efficacy and effectiveness of meditation practices for hypertension (continued)

Intervention	Comparator	Outcome	No. studies	Meta-analysis	Outcomes for Meta-analysis
Qi Gong	AHM	Plasma 18-OH-DOC levels, BP changes(DBP, SBP)[211]	1	No	NA
	Exercise	BP, health status, anxiety, depression, HR, weight, BMI, body fat, waist/hip circumference, renin excretion, urinary albumin excretion, Na, K, urea, Cr, TC, HDL-C, LDL-C, TG, aldosterone, urine cortisol, urine Cr, urine Na, urine protein, LVMI, ejection fraction[207]	1	No	NA
	WL	BP changes (DBP, SBP, RPP), HR, PR, EPI, NE, FVC, FEV1, cortisol[214] BP changes (DBP, SBP), APO-A1, TC, HDL-C, TG, self-efficacy[213]	2	Yes	BP changes (DBP, SBP)[213,214]
Tai Chi	Rest	BP changes (DBP, SBP), HR, TC, HDL-C, LDL-C, TG, BMI, anxiety[223]	1	No	NA
Yoga	AHM	Stress, BP changes (DBP, SBP), PR, weight[217]	1	No	NA
	NT	BP changes (DBP, SBP), anxiety, GSR[204] BP changes (DBP, SBP), hostility, assertive behavior, psychological symptoms[185] Stress, BP changes (DBP, SBP), PR, weight[217]	3	Yes	BP changes (DBP, SBP)[185,204,217]
	HE	BP changes (DBP, SBP), AHM intake, stress control, negative responses to stress, coping behavior, somatic symptoms, symptom severity[212] Stress, BP changes (DBP, SBP), BMI, HR[216]	2	Yes	BP changes (DBP, SBP)[212,216] Stress[212,216]
	Orthostatic tilt	BP changes (DBP, SBP), AI-EEG, CO, HR, NE, EPI, PRA, urine K, urine Na, CPR[226]	1	No	NA
	PMR	BP changes (DBP, SBP), anxiety, GSR[204]	1	No	NA
	Rest	BP changes (DBP, SBP), anxiety, GSR[204] BP changes (DBP, SBP)[219]	2	Yes	BP changes (DBP, SBP)[204,219]
	Relaxation	BP changes (DBP, SBP), body weight, urine Na, TC[224]	1	No	NA
	Yoga + BF	BP changes (DBP, SBP), hostility, assertive behavior, anxiety, depression[185]	1	No	NA
Zen Buddhist meditation	Blood pressure checks	BP changes (DBP, SBP), changes in plasma DBH, plasma volume, PRA[227] BP changes (DBP, SBP)[225]	2	Yes	BP changes (DBP, SBP) [225,227]
	NT	BP changes (DBP, SBP)[225]	1	No	NA
Mantra (NS)	NT	BP changes (DBP, SBP); time of BP restoration, HRQL, emotional stress, number of sick leaves[203]	1	No	NA
Meditation practices (NS)	NT	BP changes (DBP, SBP)[215]	1	No	NA

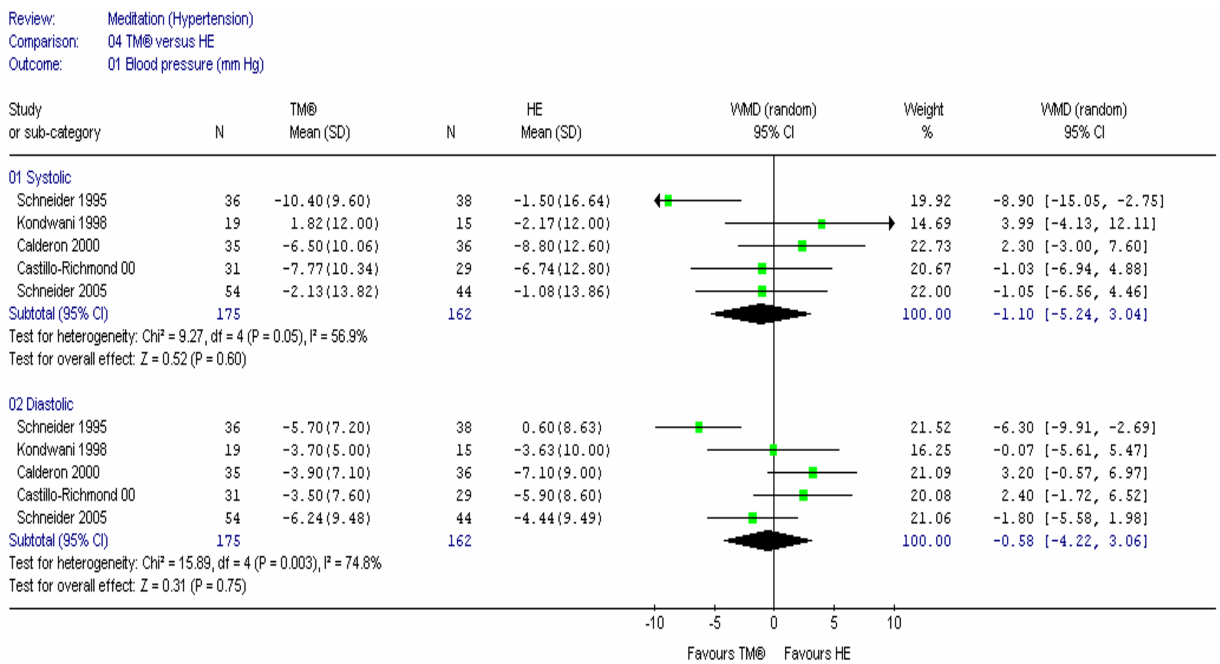
Transcendental Meditation®

Five RCTs assessing the effects of TM® in hypertensive patients were identified. Five trials[205,206,210,220,221] compared TM® versus HE, and two trials[220,221] compared TM® versus PMR. Meta-analyses were conducted for the comparisons TM® versus HE, and TM® versus PMR.

TM® versus HE

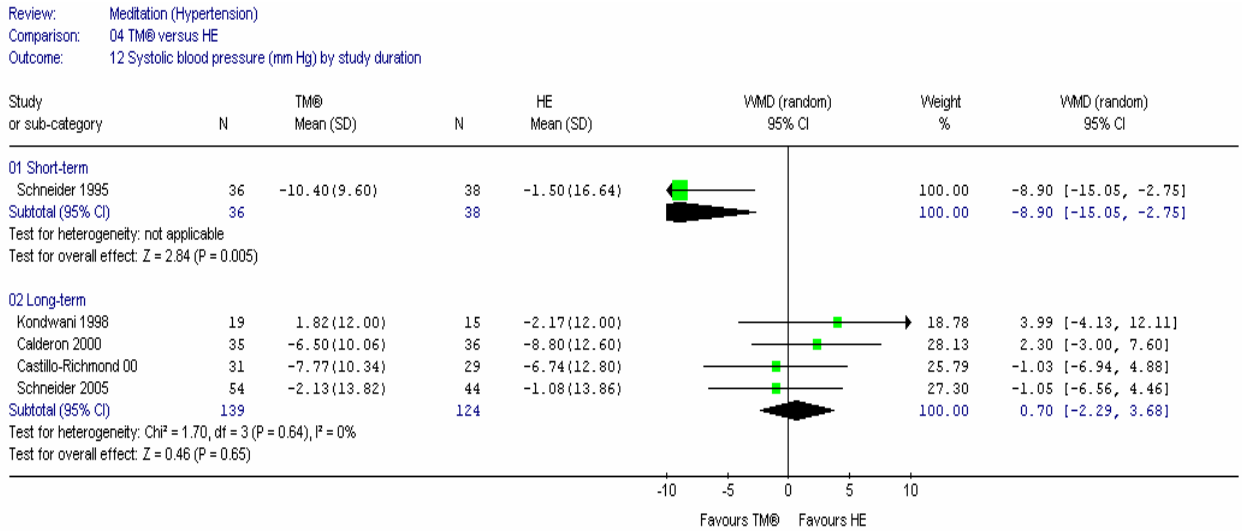
Blood pressure. Five trials[205,206,210,220,221] totaling 337 participants (TM® = 175, HE = 162) provided data on the effects of TM® versus HE on SBP and DBP (Figure 3). The combined estimate of changes in SBP (mm Hg) indicated a small, nonsignificant improvement (reduction) in favor of TM® (WMD = -1.10; 95% CI, -5.24 to 3.04). There was evidence of heterogeneity among the studies regarding the mean change in SBP ($p = 0.05$; $I^2 = 56.9$ percent).

Figure 3. Meta-analysis of the effect of TM® versus HE on blood pressure (SBP and DBP)



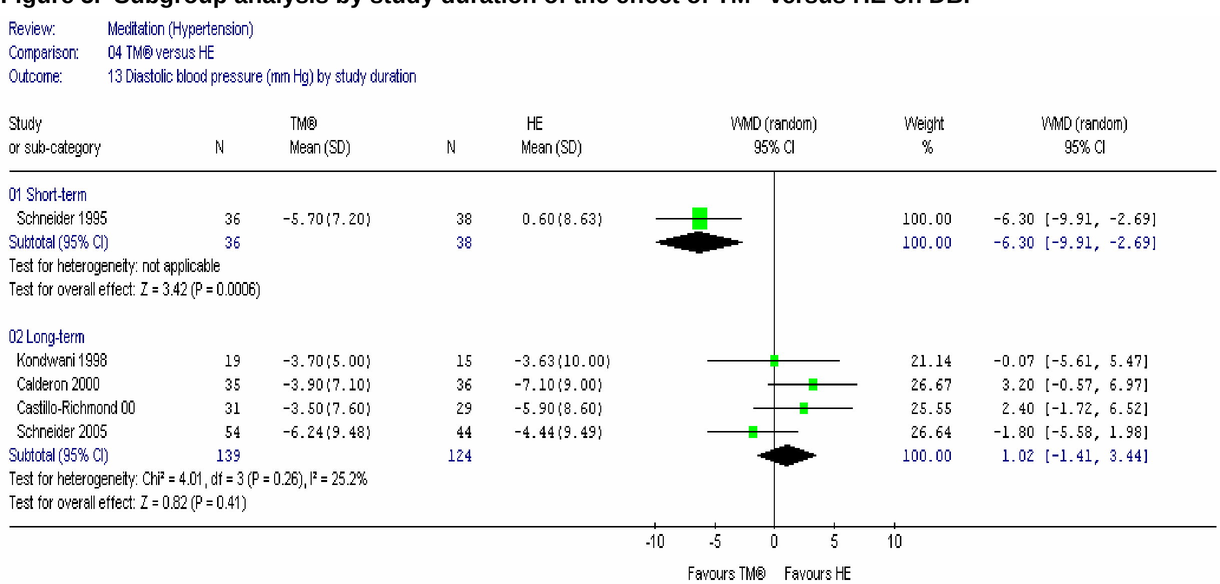
Possible causes of heterogeneity in the outcome of SBP were explored. The five trials were similar in terms of the type of participants, severity of hypertension, characteristics of the interventions, and methodological quality. There were differences, however, in the duration of the trials and followup period. All but one study[221] were medium- or long-term trials (more than 3 months). The study with the shortest duration[221] (3 months) was the only trial that reported statistically significant changes in SBP favoring TM®. The medium- or long-term trials did not find statistically significant differences between TM® and HE for changes in SBP. A subgroup analysis based on the duration of the studies (Figure 4) showed that greater homogeneity ($p = 0.64$, $I^2 = 0$ percent) was observed for the studies that assessed the medium- and long-term effects of TM® and HE on SBP. After excluding the short-term study,[221] the direction of the effect changed to a small, nonsignificant reduction of SBP in favor of HE (WMD = 0.70; 95% CI, -2.29 to 3.68).

Figure 4. Subgroup analysis by study duration of the effect of TM® versus HE on SBP



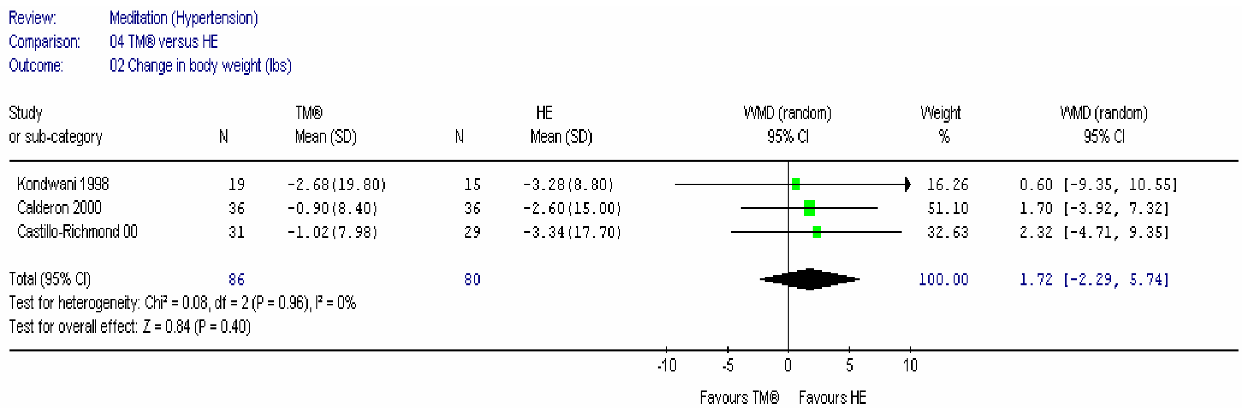
The combined estimate of changes in DBP (mm Hg) indicated a small, nonsignificant improvement (reduction) in favor of TM® (WMD = -0.58; 95% CI, -4.22 to 3.06). We found significant heterogeneity ($p = 0.003$; $I^2 = 74.8$ percent) among the studies for this outcome, which may be attributed to variations in the duration of the studies. The study with the shortest duration[221] (3 months) was the only trial that reported statistically significant changes in DBP favoring TM®. The other medium- or long-term trials did not find statistically significant differences between TM® and HE for changes in DBP. A subgroup analysis based on the duration of the studies (Figure 5) showed that greater homogeneity ($p = 0.26$, $I^2 = 25.2$ percent) was observed for the studies assessing the medium- and long-term effects of TM® and HE on DBP. After excluding the short-term study,[221] the magnitude of the effect estimate changed to a small, nonsignificant reduction of DBP in favor of HE (WMD = 1.02; 95% CI, -1.41 to 3.44).

Figure 5. Subgroup analysis by study duration of the effect of TM® versus HE on DBP



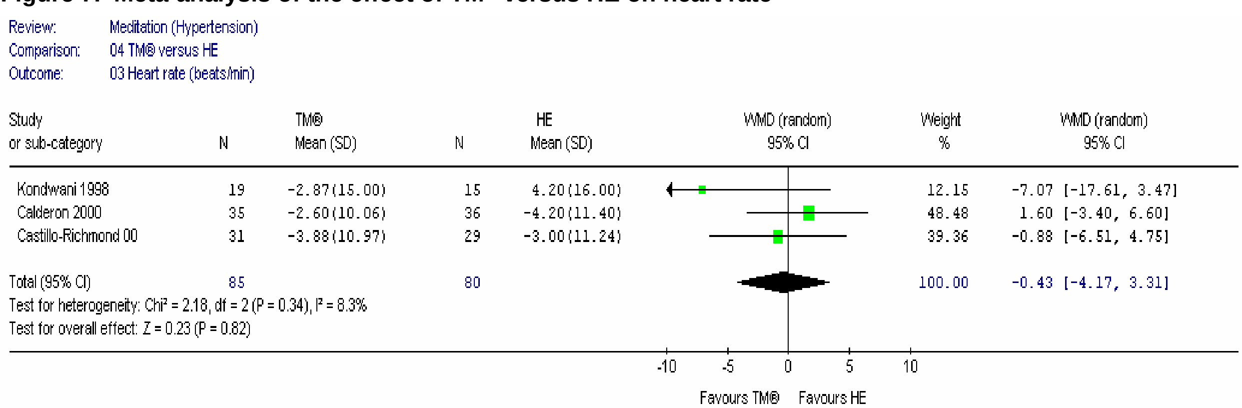
Body weight. Three trials[205,206,210] totaling 166 participants (TM® = 86, HE = 80) provided data on the effects of TM® versus HE on changes in body weight (lbs) (Figure 6). The results of the trials for changes in body weight were homogeneous (p = 0.96; I^2 = 0 percent), and the combined WMD of 1.72 (95% CI, -2.29 to 5.74) showed a greater nonsignificant improvement (reduction) in body weight in favor of HE.

Figure 6. Meta-analysis of the effect of TM® versus HE on body weight



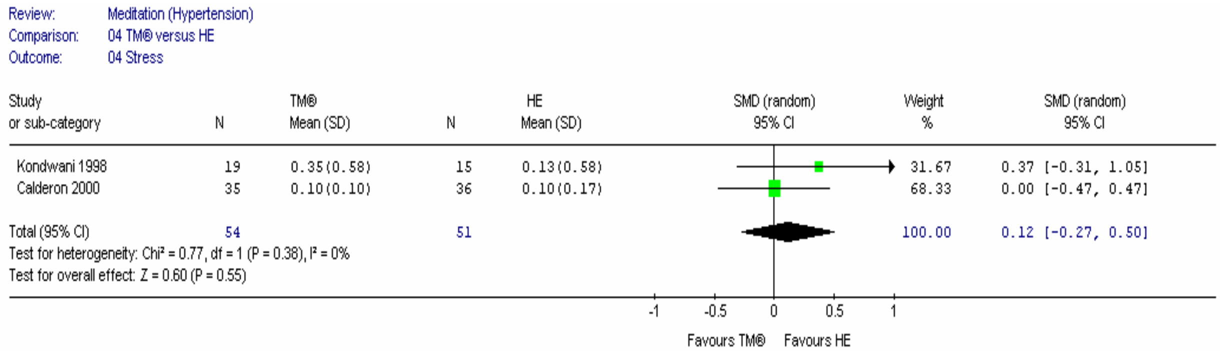
Heart rate. Three trials[205,206,210] totaling 165 participants (TM® = 85, HE = 80) provided data on the effects of TM® versus HE on heart rate (bpm) (Figure 7). The results were statistically homogeneous (p = 0.34; I^2 = 8.3 percent). The combined WMD of -0.43 (95% CI, -4.17 to 3.31) indicated a small, nonsignificant reduction in pulse rate with TM®.

Figure 7. Meta-analysis of the effect of TM® versus HE on heart rate



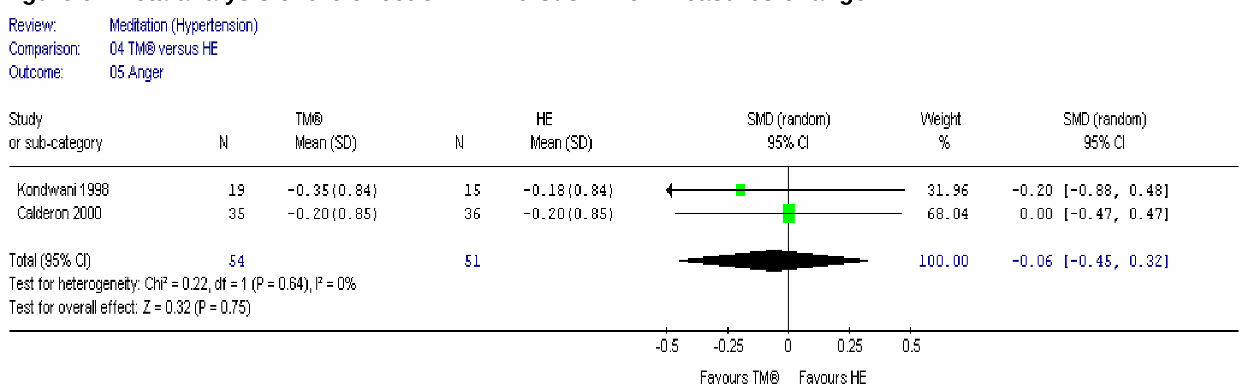
Stress. Two trials[205,210] totaling 105 participants (TM® = 54, HE = 51) contributed data on the effects of TM® versus HE on measures of stress (Figure 8). The combined estimate (SMD = 0.12; 95% CI, -0.27 to 0.50) indicated a small, nonsignificant reduction in stress scores with HE. There was evidence of homogeneity between the studies regarding the outcome of stress (p = 0.38; I^2 = 0 percent).

Figure 8. Meta-analysis of the effect of TM® versus HE on measures of stress



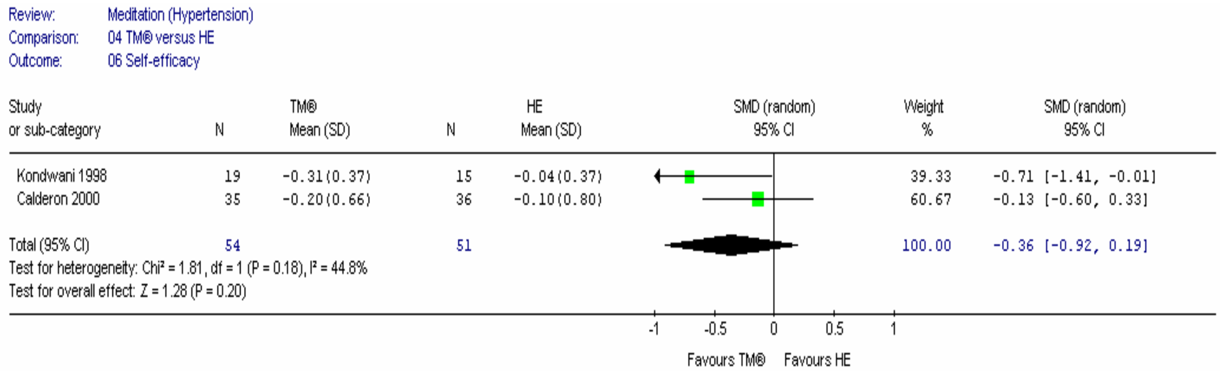
Anger. Two trials[205,210] totaling 105 participants (TM® = 54, HE = 51) examined the effects of TM® versus HE on measures of anger (Figure 9). The results of the trials for changes in measures of anger were homogeneous (p = 0.64; I^2 = 0 percent), and the combined SMD of -0.06 (95% CI, -0.45 to 0.32) showed a small and nonsignificant reduction in scores of anger with TM®.

Figure 9. Meta-analysis of the effect of TM® versus HE on measures of anger



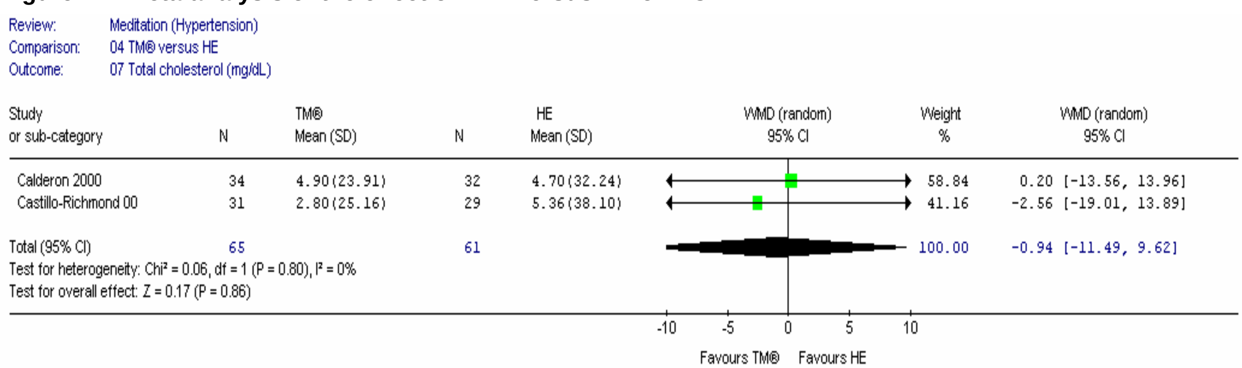
Self-efficacy. Data on changes in measures of self-efficacy were available from two trials[205,210] with a total of 105 participants (TM® = 54, HE = 51) (Figure 10). The combined SMD in measures of self-efficacy for trials of TM® compared with HE was -0.36 (95% CI, -0.92 to 0.19), and showed a nonsignificant improvement in self-efficacy in favor of TM®. The results of the trials for changes in self-efficacy were moderately heterogeneous (p = 0.18; I^2 = 44.8 percent).

Figure 10. Meta-analysis of the effect of TM® versus HE on measures of self-efficacy



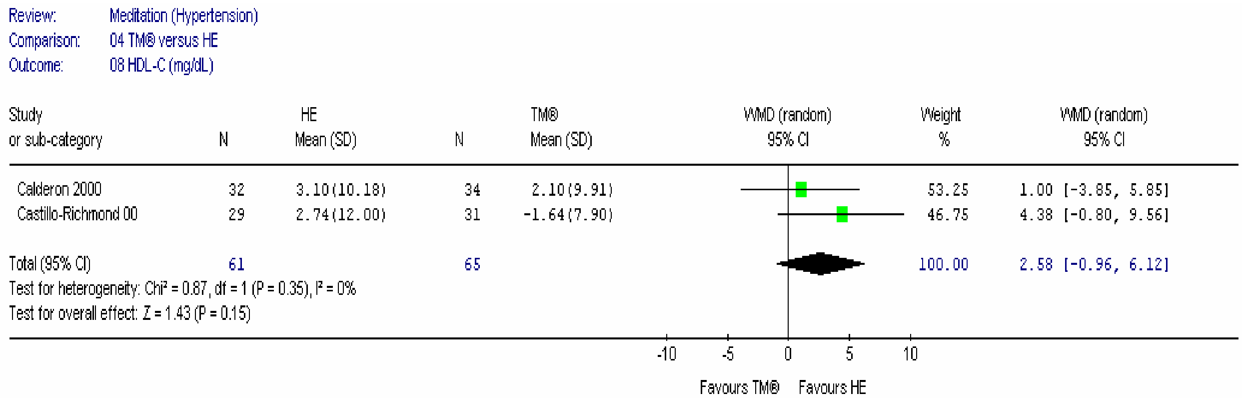
Total cholesterol (TC). Information on TC changes (mg/dL) was available from two trials[205,206] with a total of 126 participants (TM® = 65, HE = 61) (Figure 11). The combined effect estimate showed no differences between TM® and HE in TC changes (WMD = -0.94; 95% CI, -11.49 to 9.62). The results of the trials were homogeneous ($p = 0.80$; $I^2 = 0$ percent).

Figure 11. Meta-analysis of the effect of TM® versus HE on TC



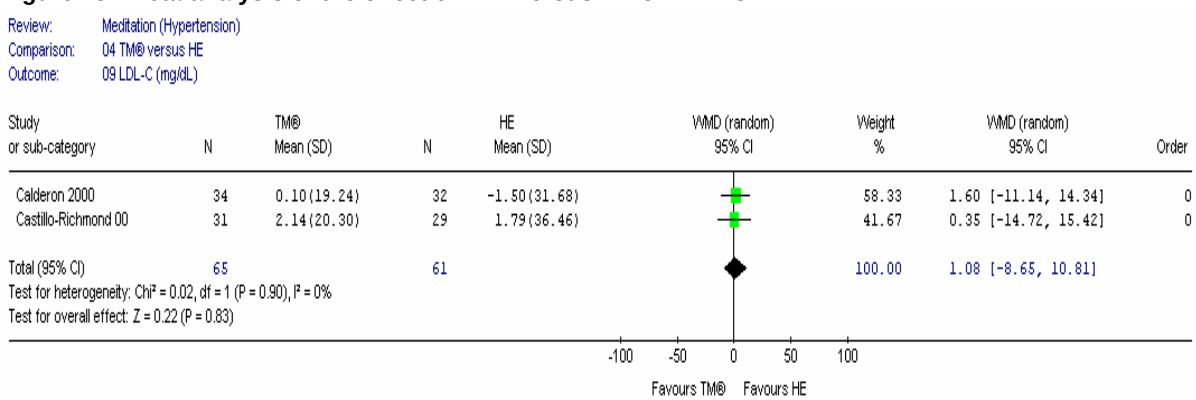
High-density lipoprotein cholesterol (HDL-C). Two trials[205,206] totaling 126 participants (TM® = 65, HE = 61) provided data on the effects of TM® versus HE on changes in HDL-C (mg/dL) (Figure 12). The results of the trials were homogeneous ($p = 0.35$; $I^2 = 0$ percent), and the combined WMD of -2.58 (95% CI, -6.12 to 0.96) showed a nonsignificant benefit (increase) with HE for HDL-C.

Figure 12. Meta-analysis of the effect of TM® versus HE on HDL-C



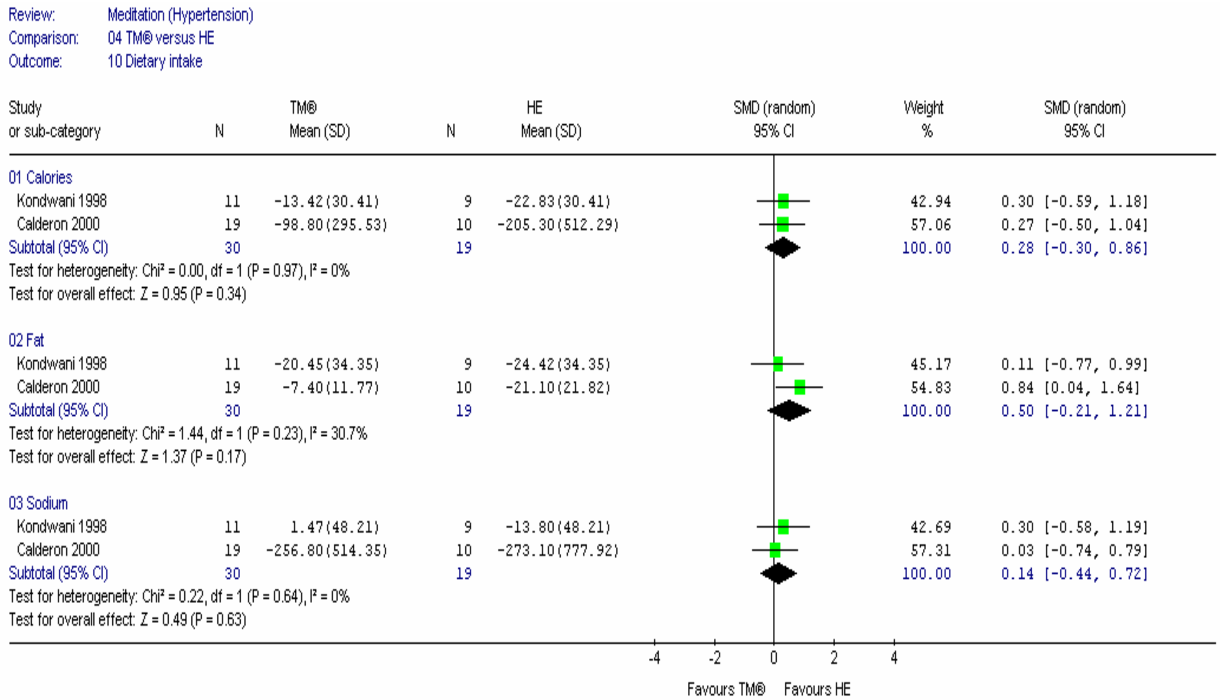
Low-density lipoprotein cholesterol (LDL-C). Two trials[205,206] totaling 126 participants (TM® = 65, HE = 61) contributed data on the effects of TM® versus HE on changes in LDL-C (mg/dL) (Figure 13). The pooled results of the trials were homogeneous ($p = 0.90$; $I^2 = 0$ percent), and the combined WMD of 1.08 (95% CI, -8.65 to 10.81) showed a nonsignificant benefit (reduction) with HE for LDL-C.

Figure 13. Meta-analysis of the effect of TM® versus HE on LDL-C



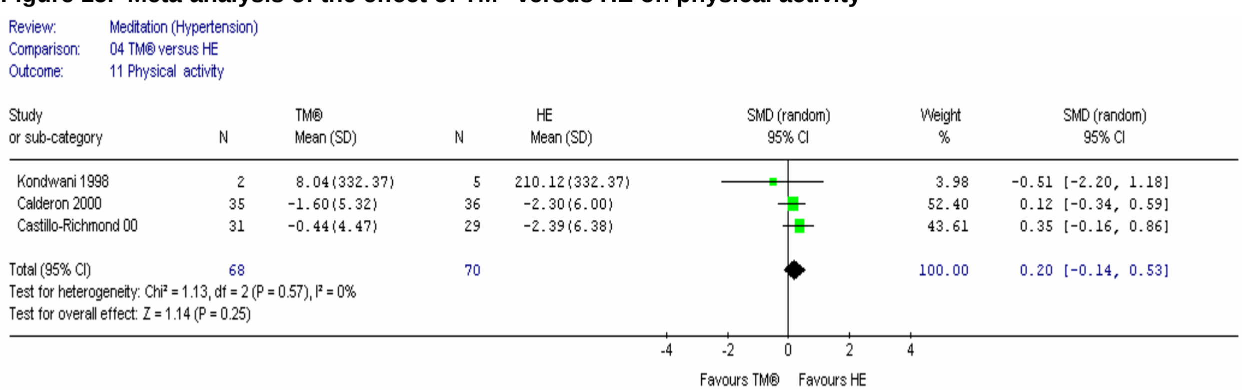
Dietary intake. Two trials[205,210] totaling 49 participants (TM® = 30, HE = 19) provided data on the effects of TM® versus HE on dietary intake, expressed as caloric intake, total fat intake, and sodium intake (Figure 14). The results of the trials for caloric intake were homogeneous ($p = 0.97$; $I^2 = 0$ percent), and the combined SMD of 0.28 (95% CI, -0.30 to 0.86) showed a nonsignificant reduction in caloric intake in the HE group. The results of the trials for total fat intake were homogeneous ($p = 0.23$; $I^2 = 30.7$ percent), and the combined SMD of 0.50 (95% CI, -0.21 to 1.21) showed a nonsignificant reduction in fat intake in the HE group. The results of the trials for sodium intake were homogeneous ($p = 0.64$; $I^2 = 0$ percent), and the combined SMD of 0.14 (95% CI, -0.44 to 0.72) showed a nonsignificant reduction in sodium intake in the HE group.

Figure 14. Meta-analysis of the effect of TM® versus HE on dietary intake



Physical activity. Three trials[205,206,210] totaling 138 participants (TM® = 68, HE = 70) provided data on the effects of TM® versus HE on changes in physical activity (Figure 15). The combined results showed a nonsignificant reduction in changes in favor of the HE group (SMD = -0.20; 95% CI, -0.14 to 0.53). The results of the trials for changes in physical activity were homogeneous (p = 0.57; I^2 = 0 percent).

Figure 15. Meta-analysis of the effect of TM® versus HE on physical activity

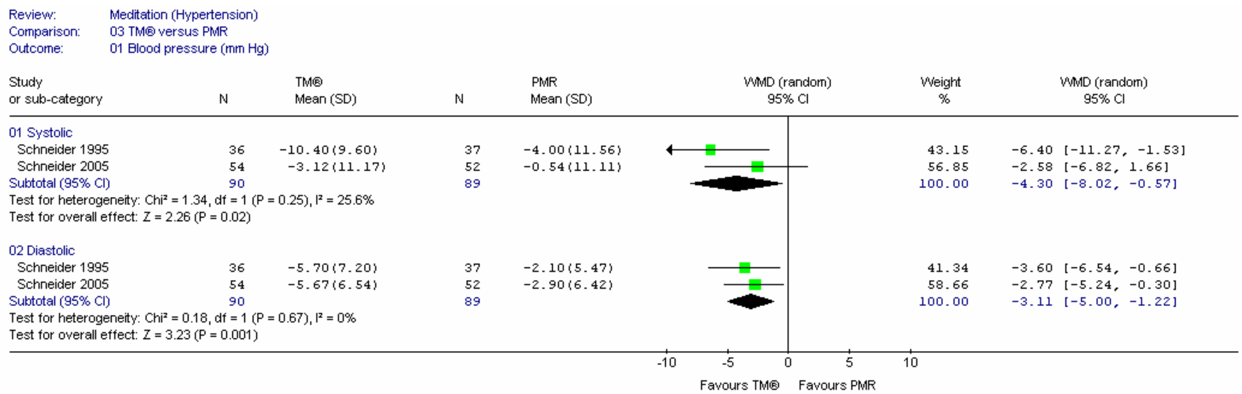


TM® versus PMR

Blood pressure. Two trials[220,221] totaling 179 participants (TM® = 90, PMR = 89) provided data on the effects of TM® versus PMR on SBP and DBP (Figure 16). The combined estimate of changes in SBP (mm Hg) indicated a significant improvement (reduction) in favor of TM® (WMD = -4.30; 95% CI, -8.02 to -0.57). The results of the trials for changes in SBP were homogeneous (p = 0.25; I^2 = 25.6 percent).

The combined estimate of changes in DBP (mm Hg) indicated a significant improvement (reduction) in favor of TM® (WMD = -3.11; 95% CI, -5.00 to -1.22). The results of the trials for changes in DBP were homogeneous (p = 0.67; I^2 = 0 percent).

Figure 16. Meta-analysis of the effect of TM® versus PMR on blood pressure (SBP and DBP)



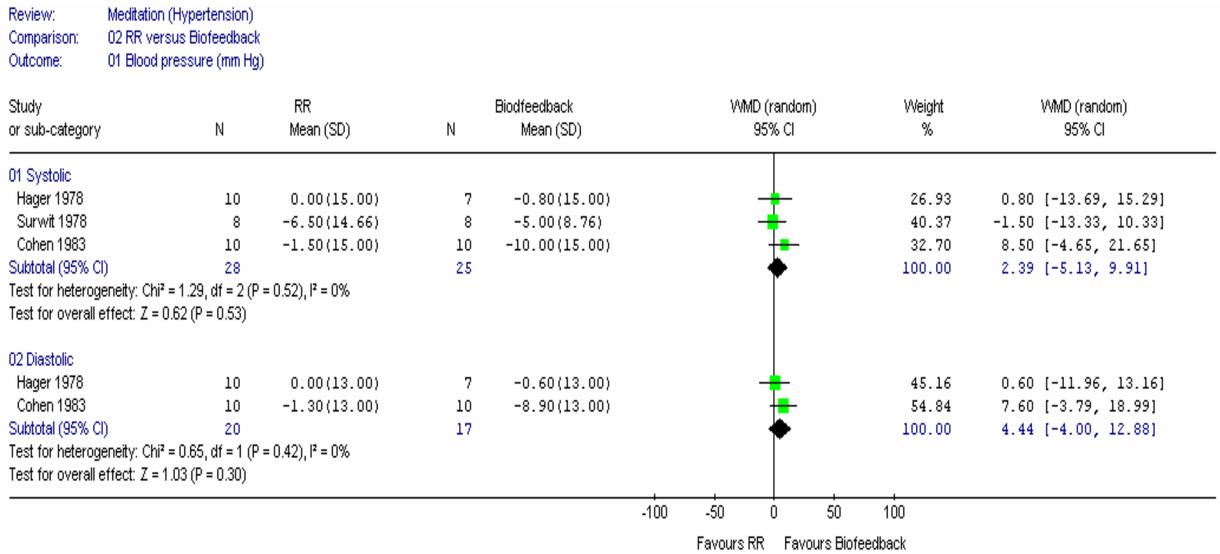
Relaxation Response

Five trials assessing the effects of RR in hypertensive patients were identified. Three trials[208,209,228] compared RR versus BF, one trial compared RR versus HE,[218] and one trial compared RR versus WL.[208] A meta-analysis was conducted for the comparison between RR and BF.

RR versus BF

Blood pressure. Three trials[208,209,228] totaling 53 participants (RR = 28, BF = 25) provided data for a meta-analysis of the effects of RR versus BF on SBP and DBP (Figure 17). The combined estimate of changes in SBP (mm Hg) showed that BF produced a greater but nonsignificant reduction in SBP when compared to RR (WMD = 2.39; 95% CI, -5.13 to 9.91). The results were homogeneous across the trials (p = 0.55; I^2 = 0 percent). Likewise, the combined estimate of changes in DBP (mm Hg) indicated a small, nonsignificant improvement (reduction) in favor of BF (WMD = 4.44; 95% CI, -4.00 to 12.88). The results of the trials for changes in DBP were homogeneous (p = 0.42; I^2 = 0 percent).

Figure 17. Meta-analysis of the effect of RR versus BF on blood pressure (SBP and DBP)



Qi Gong

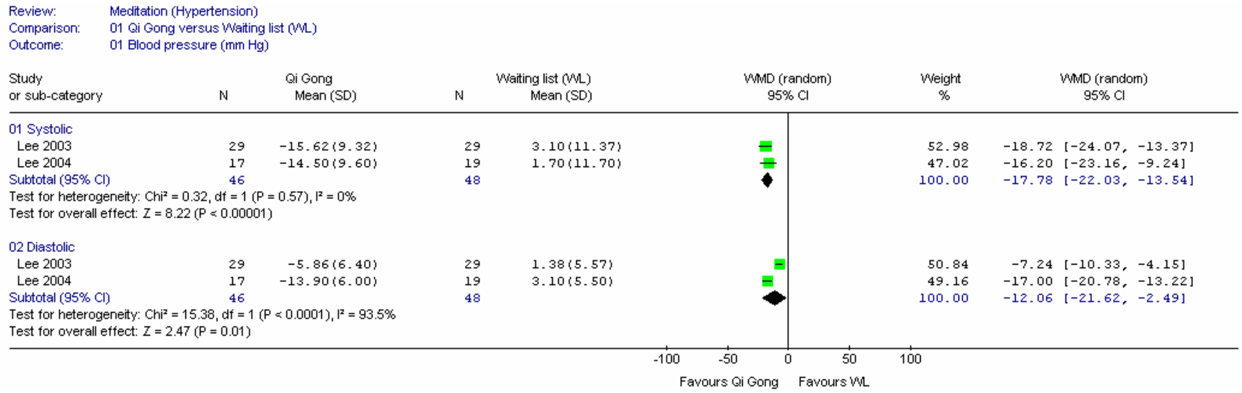
Four trials assessing the effects of Qi Gong in hypertensive patients were identified. Two trials[213,214] compared Qi Gong versus WL, one trial compared Qi Gong versus AHM,[211] and another trial[207] compared Qi Gong versus exercise. A meta-analysis was conducted for the comparison between Qi Gong and WL.

Qi Gong versus WL

Blood pressure. Two trials[213,214] totaling 94 participants (Qi Gong = 46, WL = 48) provided data for a meta-analysis of the effects of Qi Gong versus WL on SBP and DBP (Figure 18). The combined estimate of changes in SBP (mm Hg) indicated a significant improvement (reduction) in favor of Qi Gong (WMD = -17.78; 95% CI, -22.03 to -13.54). The results were homogeneous across the trials ($p = 0.57$; $I^2 = 0$ percent).

Likewise, the combined estimate of changes in DBP (mm Hg) indicated a significant improvement (reduction) of DBP in favor of Qi Gong (WMD = -12.06; 95% CI, -21.62 to -2.49). There was evidence of substantial heterogeneity among the studies in DBP ($p <0.00001$; $I^2 =$ 93.5 percent). Possible causes of heterogeneity were explored. The two trials were similar in terms of the type of participants, severity of hypertension, characteristics of the interventions, study duration, and methodological quality. Therefore, it is unknown whether clinical heterogeneity produced statistical heterogeneity between the trials for the outcome of DBP. Although each trial showed the same direction of effect, the wide confidence intervals indicate that the estimates of effect are unreliable and consistent with a broad range of possible effect sizes. Therefore, heterogeneity obscures the clinical applicability of the WMD in the analysis.

Figure 18. Meta-analysis of the effect of Qi Gong versus WL on blood pressure (SBP and DBP)



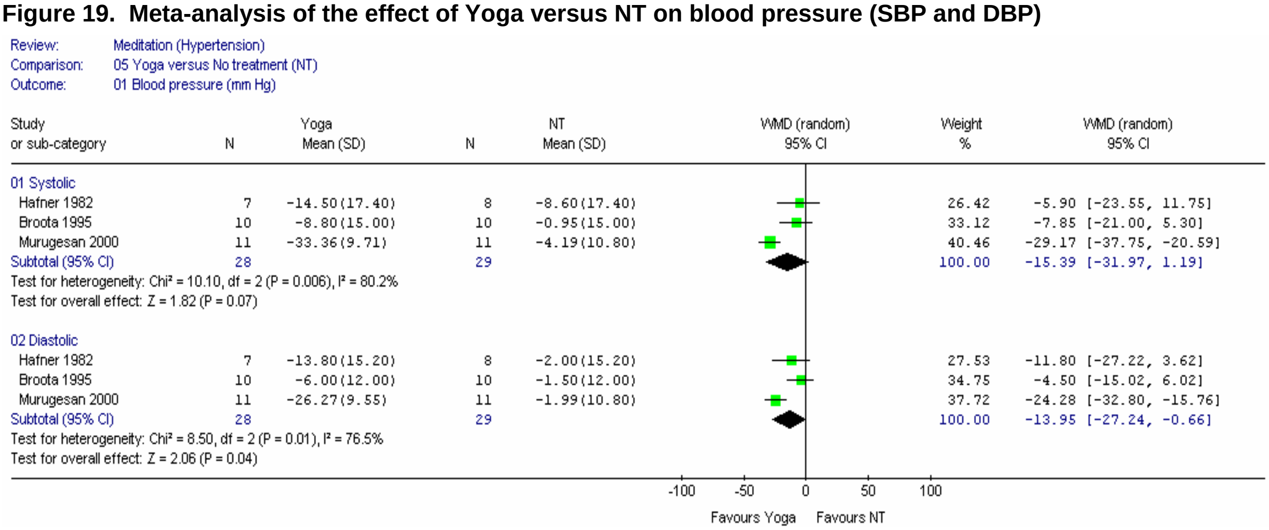
Yoga

Eight trials[185,204,212,216,217,219,224,226] assessing the effects of Yoga in hypertensive patients were identified. Three trials[185,204,217] compared Yoga versus NT, two trials[212,216] compared Yoga versus HE, two trials[204,219] compared Yoga versus rest, one trial[217] compared Yoga versus AHM, one trial[226] compared Yoga versus orthostatic tilt, one trial[204] compared Yoga versus PMR, one trial[224] compared Yoga versus relaxation, and one trial[185] compared Yoga versus a combination of Yoga and BF. Meta-analyses were conducted for the comparisons of Yoga versus NT, Yoga versus HE, and Yoga versus rest.

Yoga versus NT

Blood pressure. Three trials[185,204,217] totaling 57 participants (Yoga = 28, NT = 29) provided data for a meta-analysis of the effects of Yoga versus NT on SBP and DBP (Figure 19). The combined estimate of changes in SBP (mm Hg) indicated a small, nonsignificant improvement (reduction) in favor of Yoga (WMD = -15.39; 95% CI, -31.97 to 1.19). There was evidence of significant ($p = 0.006$) and substantial ($I^2 = 80.2$ percent) heterogeneity among the studies regarding the mean change in SBP.

Figure 19. Meta-analysis of the effect of Yoga versus NT on blood pressure (SBP and DBP)

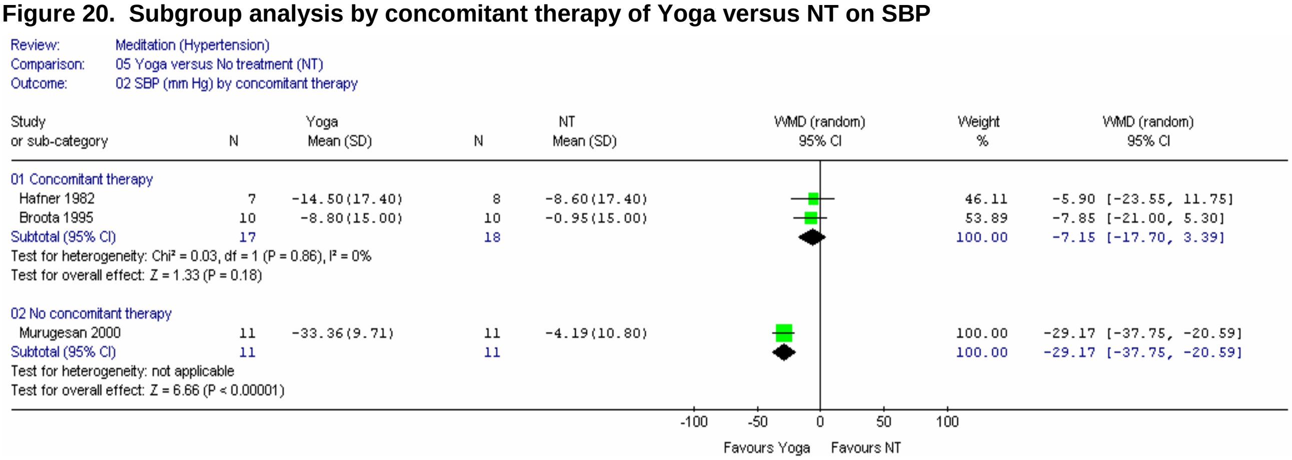


Possible causes of heterogeneity in the outcome of SBP were explored. The three trials were similar in duration and methodological quality. The studies failed to appropriately report some important characteristics that would have been useful for appraising the potential sources of heterogeneity in the trials. Age of participants was similar in two studies,[204,217] while the remaining study[185] failed to provide this information. The distribution of males and females for the total study population was also unknown in two[185,217] of the three trials. None of the studies provided a critical value for the presence or severity of hypertension. Treatment in the Broota study[204] consisted of practicing Shavasana consecutively for 8 days, with each session lasting 20 minutes. The intervention group in the trial of Hafner[185] practiced Yoga for eight 1-hour sessions at weekly intervals. Finally, participants in the Yoga group in the study of Murugesan[217] engaged in a variety of yogic practices (i.e., asanas, Om recitation, and meditation) twice a day for 1 hour, 6 days a week.

The most obvious difference among the three studies was that control participants in the Broota[204] and Hafner[185] trials were assigned to a NT condition in which existing medical treatment was not interrupted, whereas controls in the trial of Murugesan[217] did not receive any therapy. Therefore, it is likely that the conditions of NT in the Murugesan[217] study were systematically different from the other two studies. Yoga was used as an adjuvant therapy in the studies of Broota[204] and Hafner[185] whereas in the Murugesan trial[217] it was not. Murugesan[217] was the only study to report statistically significant results in favor of Yoga for changes in SBP and DBP.

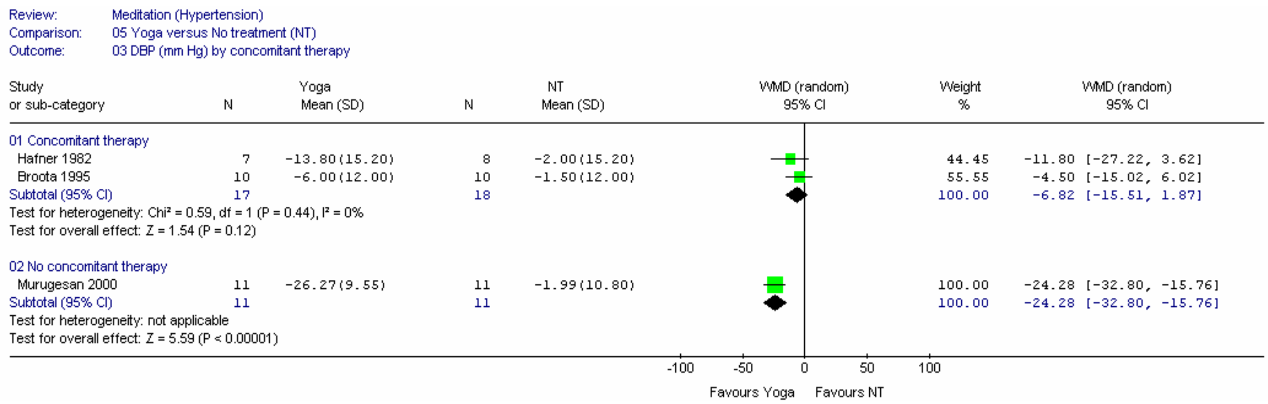
A subgroup analysis by concomitant treatment (Figure 20) showed that greater homogeneity ($p = 0.86$, $I^2 = 0$ percent) was observed for the studies that continued medical therapy in the NT condition. After excluding the study that did not provide any therapy,[217] the direction of the effect did not change, and a nonsignificant improvement (reduction) in favor of Yoga was found for SBP (WMD = -7.15; 95% CI, -17.70 to 3.39).

Figure 20. Subgroup analysis by concomitant therapy of Yoga versus NT on SBP



As depicted in Figure 19, the combined estimate of changes in DBP (mm Hg) indicated a significant improvement (reduction) in favor of Yoga (WMD = -13.95; 95% CI, -27.24 to -.0.66) There was evidence of significant heterogeneity ($p = 0.01$; $I^2 = 76.5$ percent) among the studies for this outcome, which may be accounted for by the use of concomitant therapy in the NT condition. A subgroup analysis based on the presence of concomitant treatment (Figure 21) showed that homogeneity (p = 0.44, I^2 = 0 percent) was observed for the studies that did not interrupt existing medical therapy for the NT condition. After excluding the study that did not provide any concomitant therapy,[217] the results remained similar, and a nonsignificant improvement (reduction) in favor of Yoga was found for DBP (WMD = -6.82; 95% CI, -15.51 to 1.87).

Figure 21. Subgroup analysis by concomitant therapy of Yoga versus NT on DBP

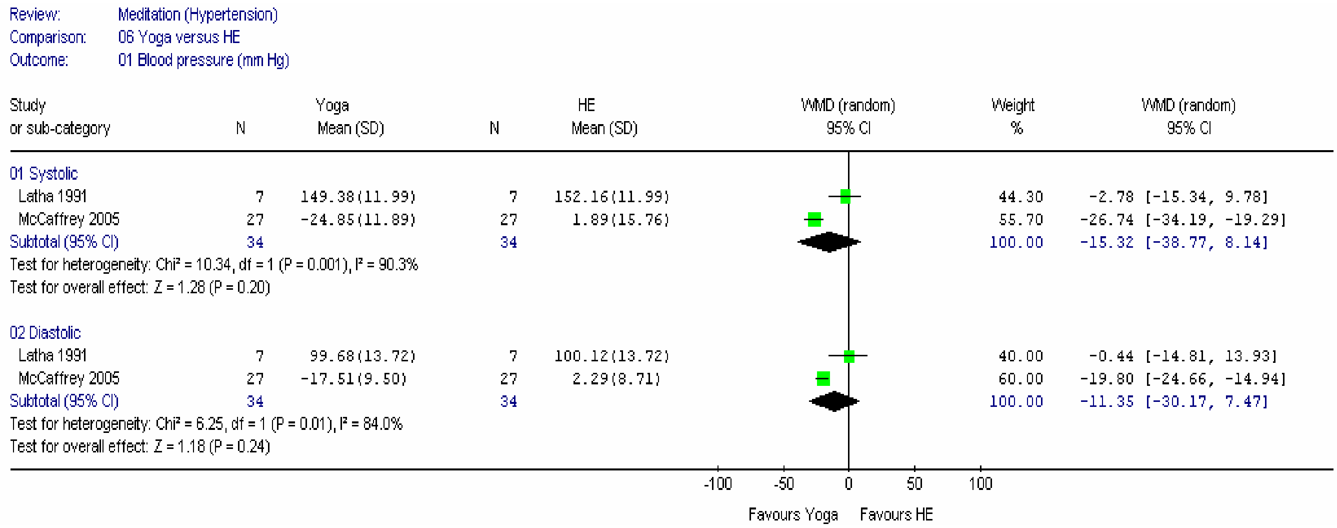


Yoga versus HE

Blood pressure. Two trials[208,212,216] totaling 68 participants (Yoga = 34, HE = 34) provided data on the effects of Yoga versus HE on SBP and DBP (Figure 22). The combined estimate of changes in SBP (mm Hg) indicated a small, nonsignificant improvement (reduction) in favor of Yoga (WMD = -15.32; 95% CI, -38.77 to 8.14). There was evidence of heterogeneity between the studies regarding the mean change in SBP (p = 0.001; I^2 = 90.3 percent). Possible causes of heterogeneity in the outcome of SBP were explored. The studies failed to report appropriately some important characteristics that would have been useful for appraising the potential sources of heterogeneity. The two trials were similar in terms of the type of participants, and methodological quality. There were differences in the duration of trials that may explain the differences in the results from the individual studies, and the heterogeneity in the pooling of the results. The Latha[212]study was a medium-term trial lasting 6 months, whereas the McCaffrey[216] study was a short-term trial of 11 weeks. The short-term trial reported statistically significant changes in SBP for Yoga as compared to HE, whereas the effects seem to disappear at medium term, as reported by the statistically nonsignificant results of the McCaffrey[216] trial.

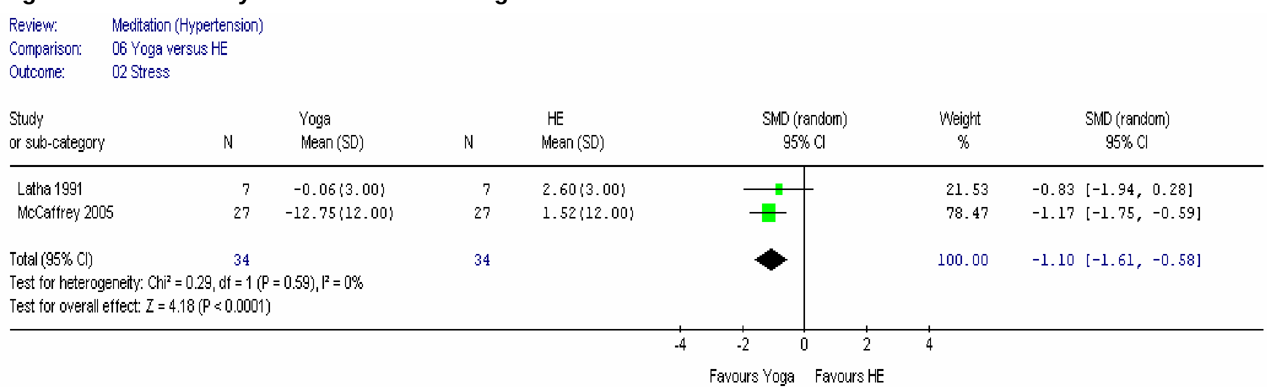
The combined estimate of changes in DBP (mm Hg) indicated a nonsignificant improvement (reduction) in favor of Yoga (WMD = -11.35; 95% CI, -30.17 to 7.47). There was evidence of significant heterogeneity (p = 0.01; I^2 = 84.0 percent) between the studies for this outcome, which may be primarily accounted for by the duration of the trials. The difference in the significance of the individual study results may be a function of the duration of the trials, with the short-term trial[212]showing statistically significant changes in DBP, and the medium term trial reporting nonstatistically significant results.

Figure 22. Meta-analysis of the effect of Yoga versus HE on blood pressure (SBP and DBP)



Stress. Two trials[208,216] totaling 68 participants (Yoga = 34, HE = 34) examined the effects of Yoga versus HE on measures of stress (Figure 23). The results of the trials for changes in measures of stress were homogeneous (p = 0.59; I^2 = 0 percent), and the combined SMD of -1.10 (95% CI, -1.61 to -0.58) showed a statistically significant reduction in scores of stress with Yoga.

Figure 23. Meta-analysis of the effect of Yoga versus HE on stress



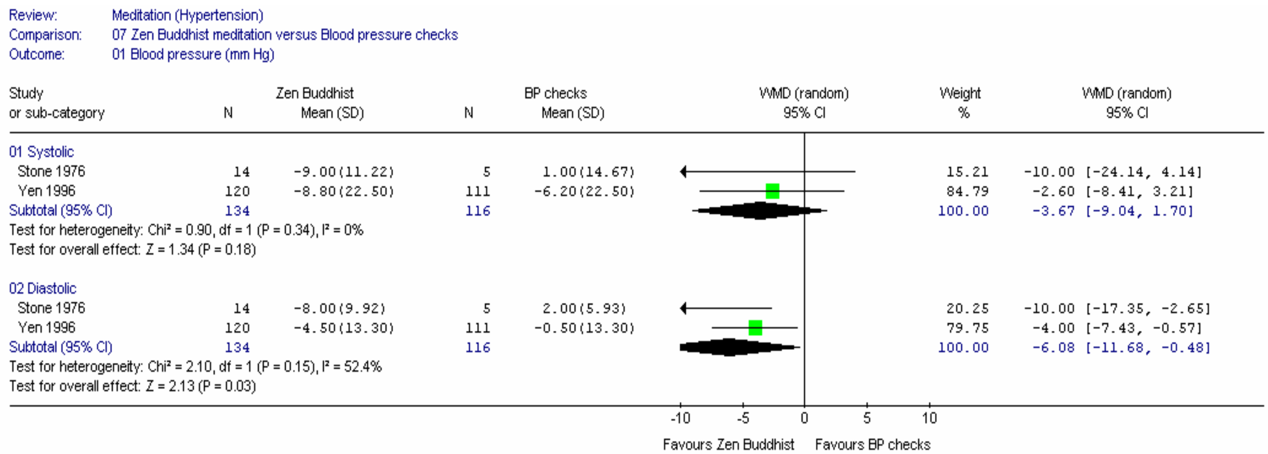
Zen Buddhist meditation

Two trials[225,227] assessing the effects of Zen Buddhist meditation in hypertensive patients were identified. The two trials were included in a meta-analysis comparing Zen Buddhist meditation versus blood pressure checks.

Zen Buddhist meditation versus blood pressure checks

Blood pressure. Two trials[225,227] totaling 250 participants (Zen Buddhist meditation = 134, blood pressure checks = 116) provided data for a meta-analysis of the effects of Zen Buddhist meditation versus blood pressure checks on SBP and DBP (Figure 24). The combined estimate of changes in SBP (mm Hg) indicated a nonsignificant improvement (reduction) in favor of Zen Buddhist meditation (WMD = -3.67; 95% CI, -9.04 to 1.70). The results were homogeneous (p = 0.34; I^2 = 0 percent). The combined estimate of changes in DBP (mm Hg) indicated a significant improvement (reduction) in favor of Zen Buddhist meditation (WMD = -6.08; 95% CI, -11.68 to -0.48). The results of the trials for changes in DBP were moderately homogeneous (p = 0.15; I^2 = 52.4 percent).

Figure 24. Meta-analysis of the effect of Zen Buddhist meditation versus blood pressure checks on blood pressure (SBP and DBP)



Mixed Treatment and Indirect Comparisons

Blood pressure. Since many of the studies of meditation practices in hypertensive patients reported data on SBP and DBP, we were able to do a mixed treatment analysis[56] which allowed us to compare all interventions to one another.

SBP. Table 28 and Figure 25 show the results of the mixed treatment comparisons for SBP, ordered by the point estimate of difference from NT. The interventions ranged from reducing SBP from an average of 0.3 to 21.9 mm Hg. Tai Chi, Yoga plus BF, and Qi Gong seem to be more effective than the other interventions in terms of point estimates and likelihood of being the best intervention. However, we cannot make strong inferences on which is the best intervention due to a lack of statistical power.

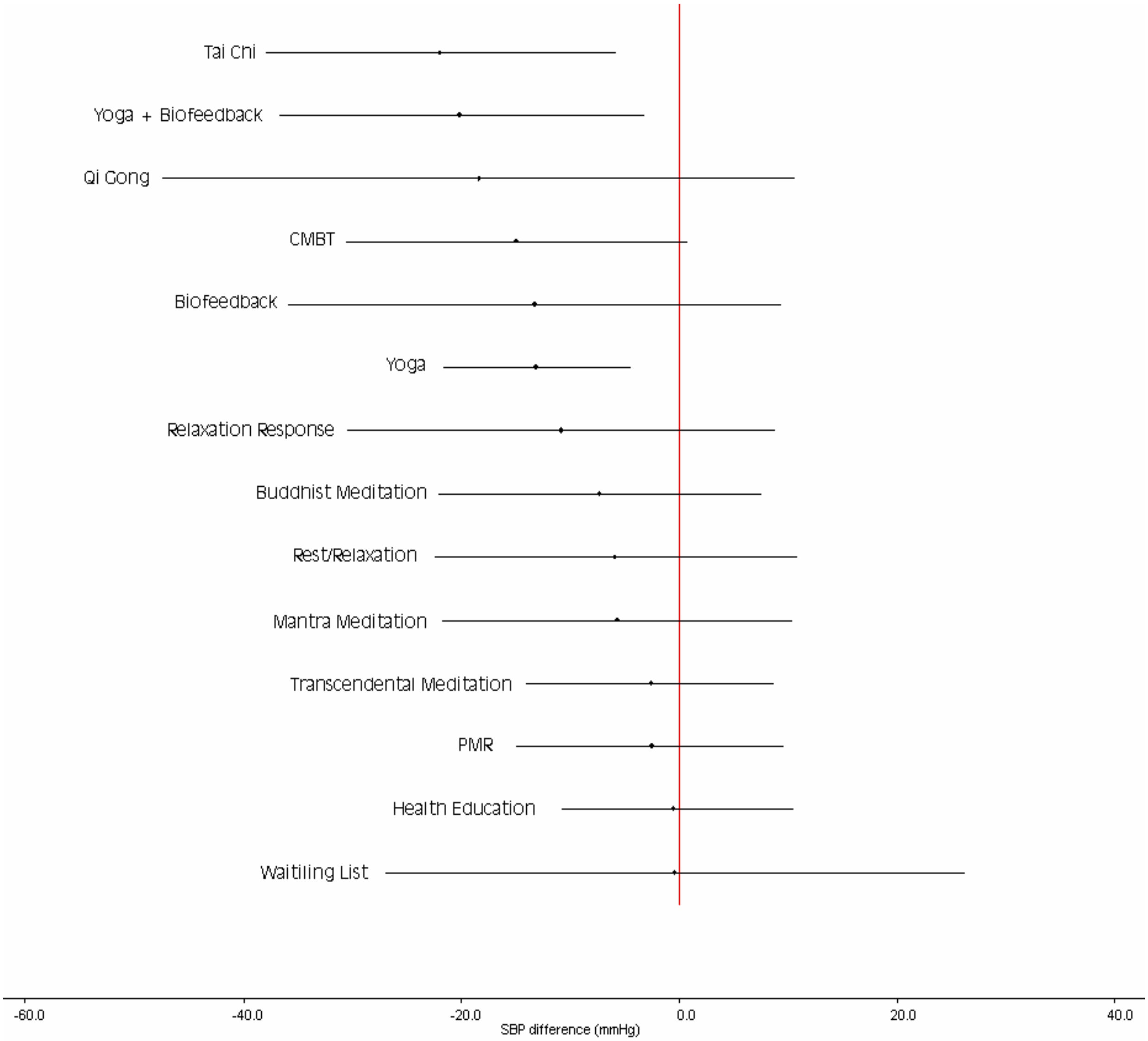
Tai Chi, Yoga plus BF, and Yoga alone all reduced SBP significantly compared to NT. Yoga, Tai Chi, and Yoga plus BF were also found to be significantly superior to HE, while Qi Gong was significantly superior to a WL control (not shown). No other pair-wise comparisons were statistically significant.

Table 28. Mixed treatment comparisons on SBP (mm Hg) reductions compared to NT

Intervention	Point estimate	95% credible interval	Probability of being "best" intervention (%)
Tai Chi	-21.9	-37.9, -5.7	32.0
Yoga + BF	-20.1	-36.7, -3.1	23.8
Qi Gong	-18.4	-47.4, 10.7	27.2
CMBT	-14.9	-30.6, 0.9	8.1
Biofeedback	-13.2	-35.9, 9.4	5.1
Yoga	-13.1	-21.7, -4.4	0.6
RR	-10.8	-30.5, 8.9	0.9
Zen Buddhist meditation	-7.3	-22.1, 7.6	0.9
Rest/Relaxation	-5.9	-22.4, 11.0	0.3
Mantra meditation (NS)	-5.6	-21.8, 10.5	1.0
TM®	-2.5	-14.0, 8.7	0.0
PMR	-2.4	-15.0, 9.6	0.0
HE	-0.5	-11.8, 10.6	0.0
WL	-0.3	-26.9, 26.3	0.0
NT	0.0	NA	0.0

BF = biofeedback; CMBT = contemplative meditation plus breathing techniques; HE = health education; NA = not applicable; NS = not specified; NT = no treatment; PMR = progressive muscle relaxation; RR = Relaxation Response; SBP = systolic blood pressure; TM® = Transcendental Meditation®; WL = waiting list

Figure 25. SBP results (point estimate and 95% credible interval) for all intervention based on mixed treatment comparisons



CMBT = contemplative meditation and breathing techniques; PMR = progressive muscle relaxation

DBP. Table 29 and Figure 26 show the results of the mixed treatment comparisons for DBP, ordered by the point estimate of difference from NT. Note that the study[215] that reported on the CMBT intervention did not report DBP and was excluded from this analysis, giving us one less intervention than the SBP analysis. The interventions ranged from reducing DBP from an average of 1.0 to 17.1 mm Hg. Yoga plus BF and Qi Gong were slightly above the other interventions in terms of point estimates and likelihood of being the best intervention, although the differences between interventions were even less than for SBP.

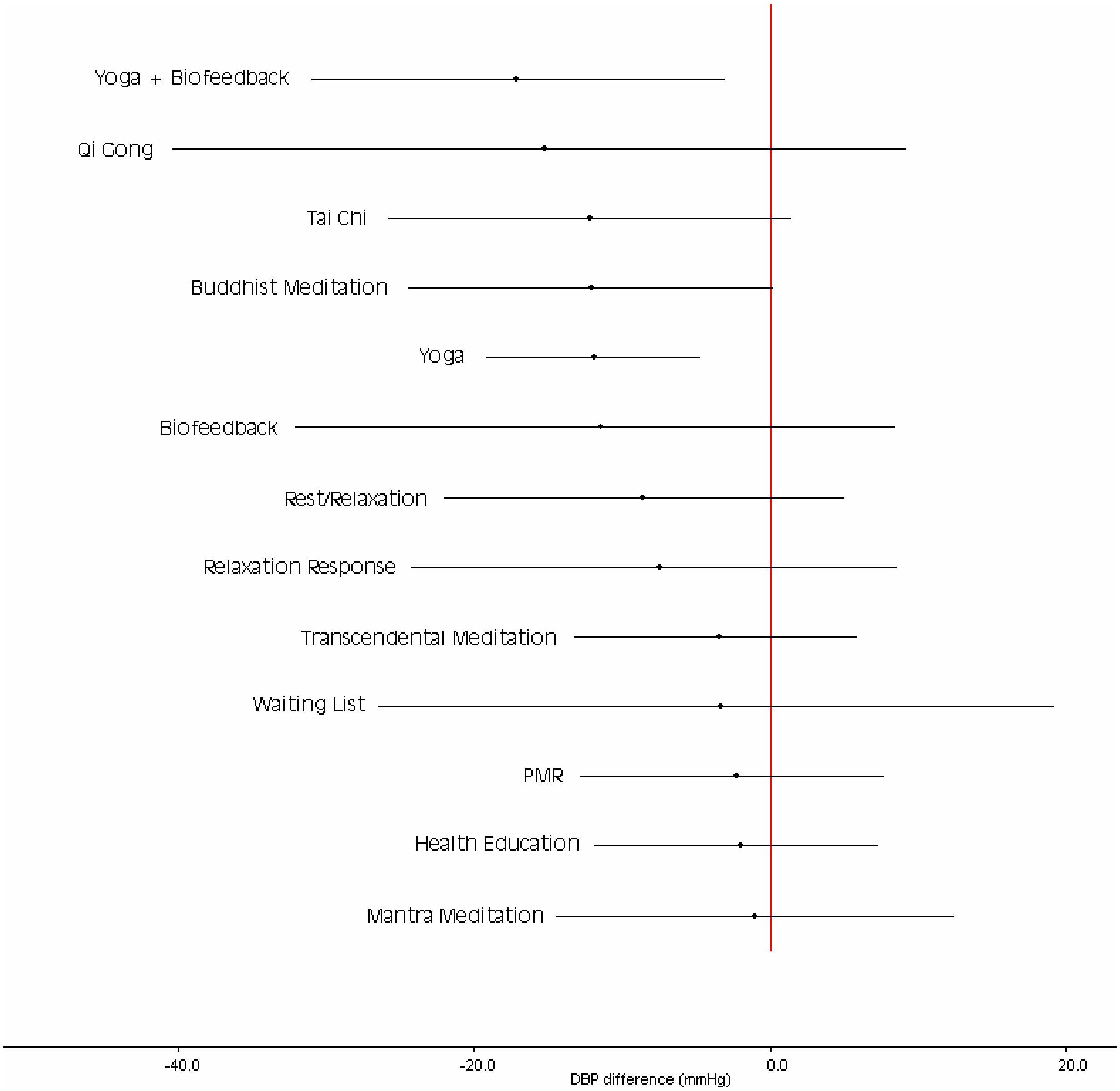
Yoga alone and Yoga plus BF were the only interventions that reduced DBP significantly compared to NT. The only other pair-wise comparisons (not shown) that were statistically significant were Yoga compared to HE and Qi Gong compared to WL.

Table 29. Mixed treatment comparisons on SBP (mm Hg) reductions compared to NT

Intervention	Point Estimate	95% Credible Interval	Probability of "best" (%)
Yoga + Biofeedback	-17.1	-30.9, -3.0	34.0
Qi Gong	-15.2	-40.4, 9.3	30.6
Tai Chi	-12.1	-25.8, 1.5	12.5
Zen Buddhist meditation	-12.0	-24.4, 0.2	9.1
Yoga	-11.8	-19.1, -4.6	1.8
BF	-11.4	-32.1, 8.5	9.2
Rest/Relaxation	-8.5	-22.0, 5.0	1.3
RR	-7.4	-24.2, 8.6	0.8
TM®	-3.4	-13.3, 5.9	0.1
WL	-3.3	-26.4, 19.3	0.0
PMR	-2.2	-12.8, 7.7	0.1
HE	-1.9	-11.8, 7.3	0.0
Mantra meditation (NS)	-1.0	-14.4, 12.4	0.6
NT	0.0	NA	0.0

BF = biofeedback; DBP = diastolic blood pressure; HE = health education; NA = not applicable; NS = not specified; NT = no treatment; PMR = progressive muscle relaxation; RR = Relaxation Response; TM® = Transcendental Meditation®; WL = waiting list

Figure 26. DBP results (point estimate and 95% credible interval) for all interventions based on mixed treatment comparisons



PMR = progressive muscle relaxation

Other indirect comparisons. We were able to make indirect comparisons between TM® and Yoga via HE for body mass index (BMI), heart rate, and stress. Yoga was nonsignificantly superior to TM® in reducing BMI (MD: -0.69; 95% CI, -2.53 to 1.15) and significantly superior in reducing both heart rate (MD: -15.6 bpm; 95% CI, -21.7 to -9.6) and stress (MD: -0.95; 95% CI, -1.76 to -0.14).

We were also able to make an indirect comparison of TM® versus RR in reducing cigarette smoking via direct comparisons with HE. RR was found to significantly reduce smoking compared to TM® (MD: -2.8; 95% CI, 0.3 to 5.4).

Analysis of Publication Bias

Because of the very small number of trials available for each comparison, the statistical tests lacked the power to detect publication bias. Therefore the analysis of the effect of publication bias on the meta-analyses presented above was not conducted.

Cardiovascular Diseases

Description of the Included Studies

Twenty-one trials (15 RCTs[91,233-246] and 6 NRCTs[247-252]) that evaluated the effects of meditation practices in individuals with cardiovascular diseases were identified. They included seven trials on Yoga,[233,238-240,247,250,251] three on Tai Chi,[235,246,248] three on RR,[91,234,236] three on mindfulness meditation (not specified),[241,242,249] two on MBSR,[244,245] one on Qi Gong,[243] one on TM®,[252] and one on Zen Buddhist meditation.[237]

The trials were published between 1988 and 2005 (median year of publication: 2002; IQR, 1998 to 2004). Fifteen of these trials have been published in journals[233-236,238-240,243,244,246,248-252] while six[91,237,241,242,245,247] were identified from the gray literature. Eleven trials[91,233,234,237,241,242,244-246,251,252] were conducted in the United States, three[239,240,250] in India, one[236] in Brazil, one[249] in China, one[247] in Germany, one[243] in Sweden, one[248] in Taiwan, and one[238] in Thailand. Characteristics of the trials are summarized in Table H2 in Appendix H.[*]A total of 1,358 individuals were assigned to meditation practices or control groups. The median sample size based on data from 20 trials was 48 participants per study (IQR, 31 to 106). Five[235,242,243,249,250] of 20 trials that provided data on sample size had more than 100 participants assigned to the study groups. The mean age of participants based on data from 17 trials was 63 ± 7 years (range: 52 to 77 years). Eight trials[91,235,238,240,241,244,248,252] were conducted in samples with mean ages ranging from 41 to 60 years. Nine trials[233,234,236,237,243,246,247,249,251] included study populations with ages above 61 years. Four trials[239,242,245,250] did not report on the age of participants.

Across all the trials that reported the gender of participants (n = 17), 70 percent were males and 30 percent were females. The samples in three trials[240,248,252] were entirely male while samples in two trials[233,244] were entirely female. Four trials[239,242,245,250] did not report the gender of participants. Five trials[91,234,241,244,246] explicitly indicated the race or ethnicity of their samples. Around 80 percent of their samples consisted of Caucasian participants, except for one trial[249] that involved Asian subjects only.

Twelve studies[237-241,243-245,247,249,250,252] were conducted in patients with coronary artery disease (CAD), as described by the primary study authors. Clinical conditions included history of myocardial infarction (MI), chronic stable angina, valve diseases, and arrhythmias. CAD diagnoses were confirmed either by angiography,[237,238,240,252] clinical history,[241,243,244,249] or combining both clinical history and electrocardiogram.[239] Three studies[245,247,250] failed to provide a description of the diagnosis criteria for inclusion in the trials. Three studies [233,242,251] were conducted in patients with coronary heart disease.

[*]Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Three studies[246,234,236] were conducted in patients with chronic hearth failure (CHF). Patients from one of the studies[246] on CHF met the functional capacity criteria for New York Heart Association (NYHA) classification I-IV. Patients in another study on CHF[234] met the criteria for NYHA functional class II-III. The remaining study on CHF[236] included patients that met both the Vasan and Lecy criteria for CHF, and the criteria for NYHA functional class I-II. Other cardiovascular conditions that were studied included acute myocardial infarction (AMI),[235] and peripheral vascular occlusive disease.[91] Finally, one study[248] was conducted in patients that underwent coronary artery bypass surgery

All 21 trials employed a parallel study design. The length of the trials varied from 90 minutes[237] to 1 year.[240,248-250] The median duration of the trials was 3 months (IQR, 2 to 9; data from 20 trials). Six studies[235,237,241,244,251,252] were short-term trials (less than 3 months in duration), nine trials[233,234,236,238,239,243,245-247] were between 3 and 6 months, and five trials[240,242,248-250] were longer than 6 months.

The 21 trials comprised 5 comparisons between meditation practices and no intervention,[235,244,245,247,251] and one comparison between meditation and WL.[252] There were 20 comparisons between meditation and active therapies other than no intervention or WL. As some trials had more than one comparison arm, the total number of comparisons exceeds the number of trials. The 20 active comparisons comprise exercise,[233,235,239,240,248] HE,[234,237,243] usual care,[234,242,246,249] group therapy,[236,241] pharmacological interventions,[238,246,250] rest,[91] listening to music,[91] and cognitive restructuring training.[241] Four studies were three-arm trials[91,234,235,241] while the remaining 17 were two-arm trials.

Methodological Quality of Included Studies

The methodological quality of the included trials as measured by the overall median Jadad score was 1/5 (IQR, 1 to 2). Two trials[91,234] obtained 3 points and were considered of high quality (i.e., Jadad scores greater than or equal to 3 points). Seven trials[235,236,238,241,243,244,246] obtained 2 points, 11 trials[233,237,239,240,242,245,248-252] obtained 1 point, and one trial[247] did not obtain any points. All the trials except six[247-252] were described as randomized; however, the description of randomization varied. The majority of trials (n = 13)[235-246,253] did not provide a description on how the randomization was performed. Two trials[91,234] described appropriate methods of generating the sequence of randomization. None of the trials were described as double-blind. The adequacy of allocation concealment was unclear in all the trials except one.[246]

An intention-to-treat analysis was specified in two trials only.[234,246] Sixteen trials[91,233-238,241,243,244,246,248-252] reported dropout information for the total study sample (mean dropout rate, 17 percent; range, 0 to 32 percent). Six trials[236,241,248,249,251,252] had a dropout rate of more than 20 percent. Withdrawals and dropouts per treatment group were clearly described in 14 trials[91,234-236,238,241,243,244,246,248-252] On average, 20 percent of participants (range, 0 to 39 percent) dropped out from the meditation groups in the 14 studies that reported dropouts. The mean dropout rate for the control groups was slightly lower (16 percent; range, 0 to 33 percent).

Eight trials[233,234,239,240,243,246,248,249] disclosed their source of funding. Seven trials[233,234,239,240,243,246,249] received funding from government sources; two[243,246] received funds from a private donor/foundation; and one[248] received internal funds. A comparative summary of the methodological quality of the included trials is provided in Table 30.

Table 30. Methodological quality of trials of meditation practices for other cardiovascular disorders

Study name	Meditation practice	Randomization		Double blinding		Description of withdrawals /dropouts	Jadad score	Allocation concealment	Report of funding
		Stated	Method described	Stated	Method described				
Ades PA, 2005[233,253]	Yoga + BE	Yes	Unclear	No	NA	No	1	Unclear	Yes
Chang BH, 2005[234]	RR	Yes	Adequate	No	NA	Yes	3	Unclear	Yes
Channer KS, 1996[235]	Tai Chi	Yes	Unclear	No	NA	Yes	2	Unclear	No
Curiati JA, 2005[236]	RR + BE	Yes	Unclear	No	NA	Yes	2	Unclear	No
Friedman NL, 2002[237]	Zen Buddhist meditation	Yes	Unclear	No	NA	No	1	Unclear	No
Hipp A, 1998[247]	Yoga	No	NA	No	NA	No	0	Unclear	No
Jatuporn S, 2003[238]	Yoga + intensive lifestyle modification	Yes	Unclear	No	NA	Yes	2	Unclear	No
Lan C, 1999[248]	Tai Chi	No	NA	No	NA	Yes	1	Unclear	Yes
Mahajan AS, 1999[239]	Yoga + diet changes	Yes	Unclear	No	NA	No	1	Unclear	Yes
Manchanda SC, 2000[240]	Yoga + diet + Aerobic exercise	Yes	Unclear	No	NA	No	1	Unclear	Yes
Mandle CL, 1988[91,254]	RR	Yes	Adequate	No	NA	Yes	3	Unclear	No
Pool JI, 1995[241]	Mindfulness meditation (NS)	Yes	Unclear	No	NA	Yes	2	Unclear	No
Quillian-Wolever RE, 2005[242]	Mindfulness meditation (NS) + HE + health coaching	Yes	Unclear	No	NA	No	1	Unclear	No

BE = breathing exercises; HE = health education; MBSR = mindfulness-based stress reduction; NA = not applicable; NS = not specified; PMR = progressive muscle relaxation; RR = Relaxation Response; TM® = Transcendental Meditation®

Table 30. Methodological quality of trials of meditation practices for other cardiovascular disorders (continued)

Study name	Meditation practice	Randomization		Double blinding		Description of withdrawals /dropouts	Jadad score	Allocation concealment	Report of funding
		Stated	Method described	Stated	Method described				
Stenlund T, 2005[243]	Qi Gong	Yes	Unclear	No	NA	Yes	2	Unclear	Yes
Tacon AM, 2003[244,255]	MBSR	Yes	Unclear	No	NA	Yes	2	Unclear	No
Tsai SL, 2004[249]	Mindfulness meditation + BE + PMR + imagery	No	NA	No	NA	Yes	1	Unclear	Yes
Williams KA, 2001[245]	MBSR	Yes	Unclear	No	NA	No	1	Unclear	No
Yeh GY, 2004[246,256]	Tai Chi	Yes	Unclear	No	NA	Yes	2	Adequate	Yes
Yogendra J, 2004[250]	Yoga + risk factors control + diet + stress management	No	NA	No	NA	Yes	1	Unclear	No
Young JW, 2001[251]	Yoga	No	NA	No	NA	Yes	1	Unclear	No
Zamarra JW, 1996[252,257]	TM®	No	NA	No	NA	Yes	1	Unclear	No

Results of Direct Comparisons

Table 31 summarizes the type of meditation practice, comparison group, and outcomes that were available for direct meta-analyses on the efficacy and effectiveness of meditation practices to treat cardiovascular diseases. No single diagnostic criterion was chosen for categorizing study populations; rather, we included all studies conducted in patients with cardiovascular disorders, as defined by the authors of the primary studies. Direct meta-analyses were conducted when two or more studies assessed the same type of meditation practice, used similar comparison groups, and had usable data for common outcomes of interest. Briefly, the majority of the comparisons from 14 studies (16 out of 18 comparisons) were not suitable for direct meta-analyses. Common clinical outcomes were absent for the following comparisons: MBSR versus NT,[244,245] mindfulness techniques not specified versus usual care,[242,249] Yoga versus exercise,[233,239,240] and Yoga versus NT.[247,251] No more than one study was available for statistical pooling of the results for mindfulness techniques not specified versus cognitive restructuring training,[241] mindfulness techniques not specified versus group therapy,[241] Qi Gong versus HE,[243] RR versus HE,[234] RR versus group therapy,[236] RR versus music,[91] RR versus usual care,[234] RR versus rest,[91] Tai Chi versus HE,[235] Tai Chi versus usual care,[246] and Zen Buddhist meditation versus HE.[237]

Data from six studies were available for direct meta-analyses to compare Tai Chi versus exercise, Yoga versus medication, and Yoga versus exercise. Outcomes of interest for which data could be combined into a direct meta-analysis were

1. heart rate; Tai Chi versus exercise;
2. total cholesterol (TC); Yoga versus medication;
3. low-density lipoprotein cholesterol (LDL-C); Yoga versus medication; and
4. body weight; Yoga versus exercise

Results from individual studies that were not included in a direct meta-analysis of clinical trials of meditation practices in cardiovascular are summarized in Table H2 in Appendix H.*

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Table 31. Summary of outcomes by meditation practice and by comparison group included in meta-analyses of the efficacy and effectiveness of meditation practices in cardiovascular diseases

Intervention	Comparator	Outcome	No. studies	Meta-analysis	Outcomes for meta-analysis
MBSR	NT	Anxiety, coping styles, emotional control, health locus of control, cortisol, breathing frequency, total catecholamines, BP changes (DBP, SBP), HRQL, perceived physical well-being[244] Depression, anxiety, anger, hostility, vitality, mental health, general health[245]	2	No	NA
Mindfulness (NS)	CRT	BP changes (DBP, SBP), HR, anxiety, depression, psychological distress, irritability, hostility[241]	1	No	NA
	UC (NS)	Coronary heart disease risk at 10 yr.[242] Anxiety, sleep, relaxation level[249]	2	No	NA
	Group therapy	BP changes (DBP, SBP), HR, anxiety, depression, psychological distress, irritability, hostility[241]	1	No	NA
Qi Gong	HE	Level of physical activity, balance, coordination, fear of falling[243]	1	No	NA
RR	HE	HRQL, VO_2 max[234]	1	No	NA
	Group therapy	NE, HRQL, VE/VCO_2 slope, VO_2, LVEF, LVDDi[236]	1	No	NA
	Music tape	Anxiety, pain, medication use, HR, BP changes (DBP, SBP), PR[91]	1	No	NA
	UC (NS)	HRQL, VO_2 max[234]	1	No	NA
	Rest	Anxiety, pain, medication use, HR, BP changes (DBP, SBP), PR[91]	1	No	NA
Tai Chi	Exercise	BP changes (DBP, SBP), secondary: HR[235] Peak VO_2, peak WR, HR[248]	2	Yes	HR[235,248]
	HE	BP changes (DBP, SBP), secondary: HR[235]	1	No	NA
	UC	HRQL, exercise capacity, BNP, VO_2 max, plasma catecholamines[246]	1	No	NA
TM	WL	Exercise tolerance, maximal workload, ST depression onset, rate-pressure product[252]	1	No	NA
Yoga	Exercise	TEE, body strength, body weight, BMI, fat-free mass, left ventricular function, VO_2 max, depression[233] Body weight, lipid profile (TC, HDL-C, LDL-C)[239] Depression, anger, anxiety, hostility, vitality, mental health[240]	3	Yes	Body weight[233,239]

BNP = B-type natriuretic peptide; BMI = body mass index; BP = blood pressure; CRT = cognitive restructuring training; DBP = diastolic blood pressure; GSH = glutathione; HDL-C = high density lipoprotein cholesterol; HE = health education; HRQL = health-related quality of life; HRV = heart rate variability; LDL-C = low density lipoprotein cholesterol; LLM = lipid lowering medication; LVEF = left ventricular ejection fraction; LVDDi = left ventricular end diastolic volume index; MBSR = mindfulness-based stress reduction; NA = not applicable; NE = norepinephrine; NT = no treatment; P-MDA = plasma malondialdehyde; PMR = progressive muscle relaxation; PR = pulse rate; SBP = systolic blood pressure; TC = total cholesterol; TEE = total energy expenditure; TG = triglycerides; TM® = Transcendental Meditation®; UC = usual care; VLDL-C = very low density lipoprotein cholesterol; VE/VCO_2 = rate of increase of ventilation per unit of increase of carbon dioxide production; VO_2 max = maximum oxygen consumption; WR = work rate

Table 31. Summary of outcomes by meditation practice and by comparison group included in meta-analyses of the efficacy and effectiveness of meditation practices in cardiovascular diseases (continued)

Intervention	Comparator	Outcome	No. studies	Meta-analysis	Outcomes for meta-analysis
Yoga (continued)	NT	TC, HDL-C, LDL C, VLDL-C, TG [247] Anxiety, somatization, tension, depression, global status, mood disturbances[251]	2	No	NA
	LLM	Total antioxidant status, vitamin C, vitamin E, TG, TC, HDL-C, LDL-C, P-MDA, erythrocyte GSH, BMI[238] TC, LDL-C, clinical improvement, caloric intake, regression of disease, anxiety, depression, myocardial perfusion[250]	2	Yes	TC[238,250] LDL-C[238,250]
Zen Buddhist meditation	HE	HRV[237]	1	No	NA

Tai Chi versus exercise

Heart rate. Two trials[235,248] totaling 99 participants (Tai Chi = 47, exercise = 52) provided data on the effects of Tai Chi versus exercise on heart rate (HR). After analyzing the substantial heterogeneity of the studies (I^2 = 70 percent), it was considered inappropriate to combine the study results into a single effect estimate. There were substantial differences between the two studies regarding the characteristics of participants in the studies, the methods to evaluate HR, study design, and the duration of the followup period. The study by Channer[235] was an 8-week RCT conducted in patients who had suffered acute MI within 3 weeks prior to enrolling in the trial. Measures of HR were taken at rest. Individual study results showed a significant benefit (reduction) in resting heart rate that favored Tai Chi over exercise. The study of Lan[248] was a 1-year NRCT conducted in patients that underwent coronary artery bypass surgery. Measures of HR were taken during exercise. Individual study results showed a nonsignificant improvement (increase) in HR during exercise as compared to Tai Chi.

Yoga versus lipid lowering medication (LLM)

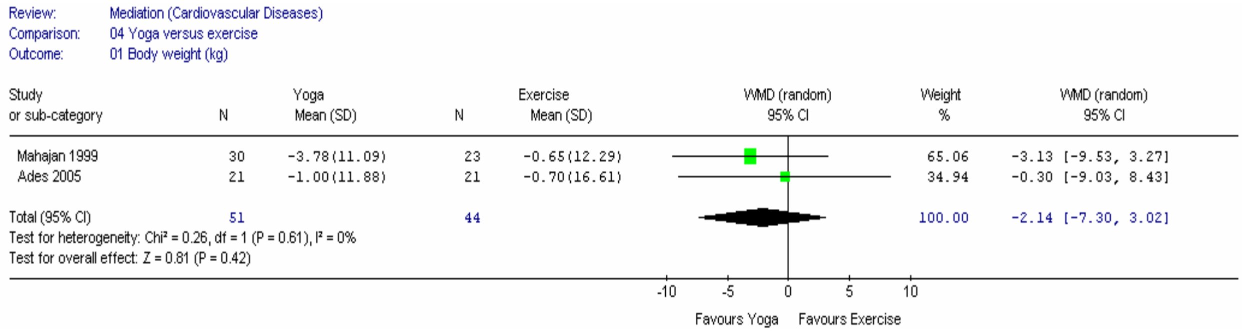
Total cholesterol (TC). Two trials[238,250] totaling 157 participants (Yoga = 93, LLM = 64) provided data on the effects of Yoga versus LLM on TC. After analyzing the substantial heterogeneity of the studies (I^2 = 97.4 percent), it was considered inappropriate to combine the study results into a single effect estimate. There were substantial differences between the two studies regarding the characteristics of participants in the studies, study design, and the duration of the followup period. The study of Jatuporn[238] was a 4-month RCT conducted in patients with coronary artery disease that compared the practice of Yoga and the administration of LLM. Individual study results showed a significant benefit (reduction) over the short-term in TC that favored LLM over Yoga. The study of Yogendra[250] was a 1-year NRCT conducted in patients with coronary artery disease that compared Yoga versus LLT. Individual study results showed a nonsignificant improvement (reduction) over the long-term in TC that favored Yoga over LLM.

Low-density lipoprotein cholesterol (LDL-C). Two trials[238,250] totaling 157 participants (Yoga = 93, LLM = 64) provided data on the effects of Yoga versus LLM on TC. As mentioned before, there was considerable clinical heterogeneity between the studies (I^2 = 97.3 percent) that precluded the pooling of the results. The short-term RCT of Jatuporn[238] reported a significant reduction in LDL-C with LLM. The long-term NRCT of Yogendra[250] showed a nonsignificant decrease in LDL-C that favored Yoga over LLM.

Yoga versus exercise

Body weight. Two trials[233,239] totaling 95 participants (Yoga = 51, exercise = 44) provided data on the effects of Yoga versus exercise on body weight changes (Figure 27). The combined estimate of changes in body weight (kg) indicated a nonsignificant improvement (reduction) in favor of Yoga (WMD = -2.14; 95% CI, -7.30 to 3.02). The results were statistically homogeneous ($p = 0.61$; I^2 = 0 percent).

Figure 27. Meta-analysis of the effect of Yoga versus exercise on body weight



Indirect Comparisons

We were able to indirectly compare changes in measures of anxiety in Yoga versus MBSR (i.e., each was compared to NT in separate studies). There was no significant difference between the two interventions in terms of measures of anxiety (SMD = 0.03; 95% CI, -1.16 to 1.22).

Analysis of Publication Bias

Because of the very small number of trials available for each comparison, the statistical tests lacked the power to detect publication bias. Therefore the analysis of the effect of publication bias on the meta-analyses presented above was not conducted.

Substance Abuse

Description of the Included Studies

Seventeen trials (13 RCTs[258-270] and 4 NRCTs[271-274]) that evaluated the effects of meditation practices in individuals with substance abuse disorders were identified. They included five trials on TM®,[259,261,267,270,271] three on Yoga,[266,269,273] two on MBSR,[263,272] two on RR,[265,268] one on CMS,[264] one on a medical meditation practice involving the use of mantra and breathing techniques,[260] one on Qi Gong,[262] one on mindfulness meditation not further specified,[258] and one on a meditation practice not further described.[274]

The trials were published between 1956 and 2004 (median year of publication: 1986; IQR, 1979 to 1999). All the trials were published in journals, except for two,[260,263] which were identified from the gray literature. The majority of trials (n = 13) [258-260,263-265,267-272,274] were conducted in the United States; two studies were conducted in India,[266,273] one study was conducted in China,[262] and one in Sweden.[261] Characteristics of the trials are summarized in Table H3 in Appendix H.*

A total of 825 individuals were assigned to meditation practices or control groups. The median sample size based on data from 16 trials was 45 participants per study (IQR, 30 to 77).

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Two[273,274] of the 16 trials had more than 100 participants assigned to the study groups. The mean age of participants based on data from 13 trials was 33 ± 7 years (range: 21 to 45 years). All the trials except two[265,270] were conducted in samples with mean ages ranging from 20 to 40 years. Four trials[259-261,273] did not report the age of participants.

Across all the trials that reported the gender of participants (n = 16), 87 percent were males and 13 percent were females. Samples in nine trials[262-266,268,270,273,274] were entirely male; none of the trials included entirely female samples. One trial[259] failed to report the gender of participants. The race of ethnicity of samples was reported in five trials.[258,263,269,270,274] African American participants constituted more than 60 percent of the study population in three trials,[258,263,270] whereas Caucasian participants constituted more than 80 percent of the study population in two trials.[269,274]

All the trials except five[217,258,266,268,269] attempted to use formal criteria or validated instruments to select participants in their studies. Two studies used the Addiction Severity Index,[258,269] one study[266] used the DSM-III criteria for alcohol dependence, and another used the Drinking Practices Questionnaire. The remaining 13 trials selected the study participants based on their reported history of substance abuse.

Participants in the studies were recruited in addiction treatment centers,[258,261,262,265,269-272,274] prisons,[259,263,267] psychiatric wards,[266] universities[264,268] or from Alcoholics Anonymous.[260,273] Abused substances included alcohol,[258,260,261,263-266,268,270-273] cocaine,[258,263,272] heroin,[258,262,269,272] marijuana,[261,272] inhalants,[272] hashish,[261] amphetamines,[261] and lysergic acid diethylamide (LSD).[261] Three studies did not provide details about the type of substances abused.

All 17 trials employed a parallel study design. The length of the trials varied from 1 day[260] to 18 months.[270] The median duration of the trials based on data from 16 trials was 4 months (IQR, 1 to 6). Seven studies[259,260,262-265,272] were short-term trials (less than 3 months), seven trials[258,261,266,268,269,271,274] had a duration between 3 and 6 months, and two trials[270,273] lasted longer than 6 months.

The 17 trials comprised four comparisons between meditation practices and no intervention,[259,262,264,272] and two comparisons between meditation practices and WL.[259,271] There were 20 comparisons between meditation practices and active therapies other than no intervention or WL. As some trials had more than one comparison arm, the total number of comparisons exceeds the number of trials. Of the 20 active comparisons, the comparative treatments were BF,[270,273] exercise,[264,266] group therapy,[261,269] PMR,[263,265] rest,[260,265] counseling,[270] psychotherapy,[273] relaxation,[274] neurotherapy,[270] stereotaxic surgery,[273] low frequency pulsed magnetic field therapy,[273] and pharmacotherapy.[262] Two studies[267,268] failed to provide a description of the control group, and one study[258] reported the comparison group as "usual care" without providing further details. The median number of comparisons per study was one (IQR, 1 to 2).

Methodological Quality of Included Studies

As a measure of methodological quality for included trials, the overall median Jadad score was 1 (IQR, 1 to 2). Three trials[258,265,266] obtained 3 points and were considered high quality (i.e., Jadad scores of 3 points or more). Three trials[260,263,264] obtained 2 points, seven trials[259,261,267-271] obtained 1 point, and four trials[262,272-274] did not obtain any points.. All the trials except four[271-274] were described as randomized; however, the description of randomization varied. The majority of trials (8 out of 13[259,261,263,264,267-270] did not provide a description on how the randomization was performed. Four trials[258,260,265,266] described an appropriate method of generating the sequence of randomization, whereas one trial[262] reported an inadequate method of sequence generation. None of the trials were described as double-blind. The adequacy of allocation concealment was unclear in all included trials.

None of the studies reported the use of intention-to-treat analysis. Eight trials[258,263-268,271] reported dropout information for the total study sample (mean dropout rate: 34 percent; range: 0 to 87 percent). Four trials[263,264,266,271] had a dropout rate of more than 20 percent. Withdrawals and dropouts per treatment group were clearly described in six trials.[258,263-266,271] Among the six studies that reported dropouts per treatment group, 24 percent of participants (range: 0 to 48 percent) dropped out from the meditation groups**.** The mean dropout rate for the control groups was similar (21 percent; range: 0 to 44 percent; eight control groups).

Seven trials[264,268-270,272-274] reported their source of funding. Five trials[268-270,273,274] received government funding and two[264,272] received internal funding. A comparative summary of the methodological quality of the included trials is provided in Table 32.

Table 32. Methodological quality of trials of meditation practices for substance abuse

Study	Meditation practice	Randomization		Double blinding		Withdrawals /dropouts described	Jadad score	Allocation concealment	Report of funding
		Stated	Method described	Stated	Method described				
Alterman AI, 2004[258]	Mindfulness meditation	Yes	Adequate	No	NA	Yes	3	Unclear	No
Ballou D, 1977[259]	TM®	Yes	Unclear	No	NA	No	1	Unclear	No
Barton MJ, 2004[260]	Medical meditation (mantra + BE)	Yes	Adequate	No	NA	No	2	Unclear	No
Brautigam E, 1977[261]	TM®	Yes	Unclear	No	NA	No	1	Unclear	No
Kline KS, 1982[271]	TM®	No	NA	No	NA	Yes	1	Unclear	No
Li M, 1956[262]	Qi Gong	Yes	Inadequate	No	NA	No	0	Unclear	No
Marcus MT, 2001[272,275]	MBSR	No	NA	No	NA	No	0	Unclear	Yes
Murphy R, 1995[263]	MBSR	Yes	Unclear	No	NA	Yes	2	Unclear	No
Murphy TJ, 1986[264]	CSM	Yes	Unclear	No	NA	Yes	2	Unclear	Yes
Parker JC, 1978[265,276,277]	RR	Yes	Adequate	No	NA	Yes	3	Unclear	No
Raina N, 2001[266]	Yoga	Yes	Adequate	No	NA	Yes	3	Unclear	No
Ramirez J, 1990[267]	TM®	Yes	Unclear	No	NA	No	1	Unclear	No
Rohsenow DJ, 1985[268]	RR + PMR + CRT	Yes	Unclear	No	NA	No	1	Unclear	Yes
Shaffer HJ, 1997[269]	Yoga + methadone	Yes	Unclear	No	NA	No	1	Unclear	Yes
Subrahmanyam S, 1986[273]	Yoga	No	NA	No	NA	No	0	Unclear	Yes
Taub E, 1994[270]	TM®	Yes	Unclear	No	NA	No	1	Unclear	Yes
Wong MR, 1981[274]	Meditation practice (NS)	No	NA	No	NA	No	0	Unclear	Yes

BE = breathing exercises; CRT = cognitive restructuring training; CSM = clinically standardized meditation; MBSR = mindfulness-based stress reduction; NA = not applicable; NS = not specified; PMR = progressive muscle relaxation; RR = Relaxation Response; TM® = Transcendental Meditation®

Results of Quantitative Analysis

Table 33 summarizes the type of meditation practice, comparison group, and outcomes that were available for meta-analysis. No single diagnostic criterion was chosen for categorizing study populations. Rather, we included all studies conducted in patients with substance abuse, as defined by the authors of the primary studies. Studies were too dissimilar in type of meditation practice, comparison group, and data for common outcomes of interest to allow direct or indirect comparisons of the effectiveness of meditation practices for substance abuse. No more than one study was available for statistical pooling of any of the 23 comparisons.

Results from individual clinical trials of meditation practices in substance abuse are summarized in Table H3 in Appendix H.[*]

Analysis of Publication Bias

The lack of trials available for a meta-analysis on the effects of meditation practices in substance abuse precluded an assessment of publication bias.

[*]Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Table 33. Summary of outcomes by meditation practice and by comparison group included in meta-analyses of efficacy and effectiveness

Intervention	Comparator	Outcome	No. studies	Meta-analysis	Outcomes for meta-analysis
TM®	NT	Anxiety, behavioral changes, inmate infractions[259]	1	No	NA
	WL	Anxiety, behavioral changes, inmate infractions[259] Personality profile, self-actualization[271]	2	No	NA
	Group therapy	Frequency of drug use, leisure activity, self-confidence, anxiety, psychomotor retardation[261]	1	No	NA
	Control (NS)	Self-concept, emotional stability, maturity, hostility, overconcern with physical symptoms[267]	1	No	NA
	BF	Drinking days, complete abstinence, mood states[270]	1	No	NA
	Neurotherapy	Drinking days, complete abstinence, mood states[270]	1	No	NA
	Counseling	Drinking days, complete abstinence, mood states[270]	1	No	NA
CSM	Exercise	Alcohol consumption, VO_2 max[264]	1	No	NA
	NT	Alcohol consumption, VO_2 max[264]	1	No	NA
MBSR	NT	Coping styles, psychopathology symptoms[272]	1	No	NA
	PMR	Egocentrism, anger, impulsivity, cortisol levels[263]	1	No	NA
Medical meditation (mantra + BE)	Rest	BP changes (DBP, SBP), PR, GSR, spirituality[260]	1	No	NA
Qi Gong	Methadone	Withdrawal symptoms, anxiety, urine morphine[262]	1	No	NA
	NT	Withdrawal symptoms, anxiety, urine morphine[262]	1	No	NA
RR	PMR	Anxiety, BP changes (DBP, SBP), HR, GSR, tension[265]	1	No	NA
	Rest	Anxiety, BP changes (DBP, SBP), HR, GSR, tension[265]	1	No	NA
	Control (NS)	Anxiety, anger, depression, alcohol consumption, locus of control, irrational beliefs[268]	1	No	NA
Yoga	Exercise	Recovery rate[266]	1	No	NA
	Group therapy	Addiction severity, psychological symptoms[269]	1	No	NA
	Psychotherapy	Clinical status, psychological status, WBC count, ESR, blood glucose, TC, cortisol, lactic acid, PBI, 5-HIAA, Hb, catecholamines, S-Ca, S-Mg, VMA; HVA; 17-KS, PT, MHPG, cholinesterase[273]	1	No	NA

5-HIAA = 5-hydroxyindole acetic acid; 17-KS = 17-ketosteroids; BE = breathing exercises; BF = biofeedback; BP = blood pressure; CSM = clinically standardized meditation; DBP = diastolic blood pressure; ESR = erythrocyte sedimentation rate; GSR = galvanic skin response; Hb = hemoglobin; HR = heart rate; HVA = homovanillic acid; LFPMF = low frequency pulsed magnetic field; MHPG = 3-methoxy-4-hydroxyphenylglycol; MBSR = mindfulness-based stress reduction; NA = not applicable; NS = not specified; NT = no treatment; PBI = protein bound iodine; PMR = progressive muscle relaxation; PR = pulse rate; RR = Relaxation Response; SBP = systolic blood pressure; S-Ca = serum calcium; S-Mg = serum magnesium; TC = total cholesterol; TM® = Transcendental Meditation®; VMA = vanillylmandelic acid; WL = waiting list; WBC = white blood cell

Table 33. Summary of outcomes by meditation practice and by comparison group included in meta-analyses of efficacy and effectiveness (continued)

Intervention	Comparator	Outcome	No. studies	Meta-analysis	Outcomes for meta-analysis
Yoga (continued)	Stereotaxic surgery	Clinical status, psychological status, WBC count, ESR, blood glucose, TC, cortisol, lactic acid, PBI, 5-HIAA, Hb, catecholamines, S-Ca, S-Mg, VMA; HVA; 17-KS, PT, MHPG, cholinesterase[273]	1	No	NA
	BF	Clinical status, psychological status, WBC count, ESR, blood glucose, TC, cortisol, lactic acid, PBI, 5-HIAA, Hb, catecholamines, S-Ca, S-Mg, VMA; HVA; 17-KS, PT, MHPG, cholinesterase[273]	1	No	NA
	LFPMF	Clinical status, psychological status, WBC count, ESR, blood glucose, TC, cortisol, lactic acid, PBI, 5-HIAA, Hb, catecholamines, S-Ca, S-Mg, VMA; HVA; 17-KS, PT, MHPG, cholinesterase[273]	1	No	NA

Summary of the Results

Table 34 summarizes the results of the meta-analyses of the treatment effects (statistical and clinical significance) of meditation practices in hypertension and cardiovascular diseases.

Hypertension

Twenty-seven trials (24 RCTs, and 3 NRCTs) have evaluated the effects of meditation practices in hypertension. The majority of trials on hypertension have been conducted in Yoga (eight studies). The trials have been predominantly conducted in the United States in participants with a mean age of 51 years (range: 41 to 60 years). All studies were conducted in patients with a diagnosis of essential hypertension and used a parallel-group design. The majority of the trials were short- and medium-term. Comparison groups included HE, NT, WL, BF, PMR, and rest. The methodological quality of trials was low with only two trials considered high quality.

Data from 16 studies were available for direct meta-analyses. Outcomes suitable for meta-analysis included blood pressure, body weight, heart rate, total cholesterol, HDL-C, LDL-C, dietary intake, physical activity, and psychological measures such as stress, anger, and self-efficacy.

Direct meta-analyses showed that compared to HE, TM® did not produce significantly greater benefits on blood pressure (SBP and DBP), heart rate, TC, HDL-C, LDL-C, body weight, dietary intake, physical activity, measures of stress, anger, and self-efficacy. A subgroup analysis by study duration showed short-term significant improvement in SBP with TM®, but not over the long-term. When compared to PMR, TM® produced significantly greater benefits in SBP and DBP. When RR was compared to BF, RR did not produce significantly greater benefits on blood pressure (SBP and DBP). Qi Gong was significantly more effective than a WL in reducing SBP. Compared to NT, Yoga produced significant reductions in DBP, but not in SBP. As the results among trials were heterogeneous, a subgroup analysis showed that the effect of Yoga on SBP was significantly greater when compared to a control group without an adjuvant treatment. The same subgroup analysis was conducted for the outcome of DBP and the magnitude of the effect changed from significant to nonsignificant when Yoga was compared to a control group with an adjuvant treatment. When compared to HE, Yoga did not produce significantly greater benefits on SBP and DBP. Heterogeneity in this outcome suggested that short-term trials showed statistically significant benefits in blood pressure, whereas the effects decreased over time. Compared to HE, Yoga produced significant benefits in controlling stress. When compared with blood pressure checks, Zen Buddhist meditation did not produce significantly greater reduction in SBP, but did produce a significant reduction in DBP.

When Tai Chi, Yoga plus BF, and Yoga were indirectly compared with NT, they significantly reduced SBP. These three interventions were also better than HE to reduce SBP. For the outcome of DBP, Yoga plus BF and Yoga alone were the only interventions that significantly reduced DBP when compared to NT. Yoga was also better than HE. Yoga was nonsignificantly superior to TM® for the outcomes of body weight, heart rate and stress. Compared to TM®, RR significantly helped to reduce smoking.

Cardiovascular Diseases

Twenty-one trials (15 RCTs and 6 NRCTs) have evaluated the effects of meditation practices in cardiovascular diseases. The majority of trials have been conducted in Yoga (seven studies). The trials have been predominantly conducted in the United States in participants with a mean age of 63 years (range: 52 to 77 years). Clinical conditions of study populations included MI, coronary artery disease, angina, arrhythmias, peripheral occlusive disease, and congestive heart failure. All studies used a parallel-group design. The majority of the trials were medium-term. Comparison groups included exercise, no intervention group, pharmacological interventions, HE, usual care not specified, group therapy, WL, listening to music, cognitive restructuring training. The methodological quality of trials was low with only two trials considered high quality.

Data from six studies were available for direct meta-analyses. Outcomes suitable for meta-analysis included TC, LDL-C, and body weight; however, only the results from the two trials comparing the use of Yoga with exercise for the reduction of body weight could be combined. This direct meta-analysis showed that Yoga was no better than exercise at producing changes in body weight. Indirect comparisons showed that there were no significant differences in measures of anxiety between Yoga and MBSR.

Table 34. Summary of the meta-analyses of the treatment effects of meditation practices in hypertension and cardiovascular diseases (statistical and clinical significance)

Comparison	Outcome	Statistical significance	Clinical significance
Hypertension			
TM® versus HE	SBP	Medium and Long-term WMD = 0.70 mm Hg (95% CI, -2.29 to 3.68) **TM® no better than HE**	No
	DBP	WMD = 1.02 mm Hg (95% CI, -1.41 to 3.44) **TM® no better than HE**	No
	Body weight	WMD = 1.72 lbs (95% CI, -2.29 to 5.74) **TM® no better than HE**	No
	Heart rate	WMD = -0.43 bpm (95% CI, -4.17 to 3.31) **TM® no better than HE**	No
	Stress	SMD = 0.12 (95% CI, -0.27 to 0.50) **TM® no better than HE`**	No
	Anger	SMD = 0.06 (95% CI, -0.45 to 0.32) **TM® no better than HE**	No
	Self-efficacy	SMD = -0.36 (95% CI, -0.92 to 0.19) **TM® no better than HE**	No
	TC	WMD = -0.94 mg/dL (95% CI, -11.49 to 9.62) **TM® no better than HE**	No
	HDL-C	WMD of -2.58 mg/dL (95% CI, -6.12 to 0.96) **TM® no better than HE**	No
	LDL-C	WMD of 1.08 mg/dL (95% CI, -8.65 to 10.81) **TM® no better than HE**	No
	Dietary intake	Fat intake: SMD = 0.50 (95% CI, -0.21 to 1.21) Sodium intake: SMD = 0.14 (95% CI, -0.44 to 0.72) **TM® no better than HE**	No

BF = biofeedback; DBP = diastolic blood pressure; HDL-C = high-density lipoprotein cholesterol; HE = health education; LDL-C = low-density lipoprotein cholesterol; MBSR = mindfulness-based stress reduction; RR = Relaxation Response; SBP = systolic blood pressure; SMD = standardized mean difference

Table 34. Summary of the meta-analyses of the treatment effects of meditation practices in hypertension and cardiovascular diseases (statistical and clinical significance) (continued)

Hypertension (continued)			
Comparison	**Outcome**	**Statistical significance**	**Clinical significance**
TM® versus HE (continued)	Physical activity	SMD = -0.20 (95% CI, -0.14 to 0.53) **TM® no better than HE**	No
TM® versus PMR	SBP	WMD = -4.30 mm Hg (95% CI, -8.02 to -0.57) **TM® better than PMR**	Yes
	DBP	WMD = -3.11 mm Hg (95% CI, -5.00 to -1.22) **TM® better than HE**	Borderline
RR versus BF	SBP	WMD = 2.39 mm Hg (95% CI, -5.13 to 9.91) **RR no better than BF**	No
	DBP	WMD = 4.44 mm Hg (95% CI, -4.00 to 12.88) **RR no better than BF**	No
Qi Gong versus WL	SBP	WMD = -17.78 mm Hg (95% CI, -22.03 to -13.54) **Qi Gong better than WL**	Questionable
	DBP	WMD = -12.06 mm Hg (95% CI, -21.62 to -2.49) **Qi Gong better than WL**	Questionable
Yoga versus NT	SBP	With concomitant therapy: WMD = -7.15 mm Hg (95% CI, -17.70 to 3.39) **Yoga no better than NT**	No
	DBP	With concomitant therapy: WMD = -6.82 mm Hg (95% CI, -15.51 to 1.87) **Yoga no better than NT**	No
Yoga versus HE	Stress	SMD = -1.10 (95% CI, -1.61 to -0.58) **Yoga better than HE**	No
Zen Buddhist meditation versus blood pressure checks	SBP	WMD = -3.67 mm Hg (95% CI, -9.04 to 1.70) **Zen Buddhist meditation no better than blood pressure checks**	No
	DBP	WMD = -6.08 mm Hg (95% CI, -11.68 to -0.48) **Zen Buddhist meditation better than blood pressure checks**	Yes
Cardiovascular diseases			
Comparison	**Outcome**	**Statistical significance**	**Clinical significance**
Yoga versus exercise	Body weight	WMD = -2.14 (95% CI, -7.30 to 3.02 **Yoga no better than exercise**	No
MBSR versus Yoga (indirect comparison)	Anxiety	No; SMD: 0.03; 95% CI, -1.16 to 1.22 **MBSR no better than yoga**	No

Substance Abuse

Seventeen trials (13 RCTs and 4 NRCTs) have evaluated the effects of meditation practices in substance abuse. The majority of trials have been conducted on TM® (five studies). The trials have been predominantly conducted in the United States in participants with a mean age of 33 years (range: 21 to 45 years). All studies used a parallel-group design. The majority of the trials were short- and medium- term. Control groups included BF, exercise, group therapy, PMR, rest, counseling, psychotherapy, relaxation, neurotherapy, stereotaxic surgery, low frequency pulsed magnetic field therapy, and pharmacotherapy. The methodological quality of trials was low with only three trials considered high quality. Study results were not combined because the trials were too dissimilar in meditation practice, comparison group, and data for common outcomes of interest. In addition, the results of the three highest quality trials[258,265,266] (Jadad score = 3/5) examining, respectively, Mindfulness meditation, RR, and Yoga are inconclusive with respect to the effectiveness of meditation pratices.

The study comparing Mindfulness meditation with usual care (NS) [258] for alcohol and cocaine abuse found little indication that Mindfulness meditation enhanced treatment outcomes for substance abuse patients. The study comparing RR with PMR and rest groups[265] for alcohol abuse found generalized effects for BP, but not for the other outcome measures (anxiety, HR, and GSR). The RR and PMR groups did not exhibit increased BP as observed in control subjects. RR and PMR produced significant changes in tension. The study comparing Yoga with exercise[266] for alcohol abuse found a significantly greater recovery rate for the Yoga group.

Table 32 provides a summary of the meta-analyses of the treatment effects of meditation practices in hypertension and cardiovascular diseases in terms of the statistical and clinical significance of the findings. Overall, we found that TM® had no advantages over HE to improve measures of SBP, DBP, body weight, heart rate, stress, anger, self-efficacy, cholesterol, dietary intake, and level of physical activity in hypertensive patients. Compared to PMR, TM® produced clinically and statistically significant benefits to reduce SBP. The results for DBP were of borderline clinical significance. Caution should be exerted when interpreting these results. Meta-analyses were derived from only two open label trials; therefore, performance bias and detection bias may have contributed to an overestimate of the treatment effect. RR was not shown to be superior to BF at reducing blood pressure in hypertension.

Qi Gong was superior to WL to reduce blood pressure in subjects with essential hypertension; however, the clinical significance of this finding is questionable, as the effect estimate is quite imprecise (i.e., wide confidence interval), the comparison is based on a few low-quality studies, and the appropriateness of a WL comparison group is questionable. Yoga did not produce clinically or statistically significant effects in blood pressure when compared to NT. Compared to HE, Yoga produced statistically significant changes in measures of stress. The clinical value of this change, however, is questionable (approximately a one-point reduction in measures of stress). Results were obtained from only two open label trials and this could have affected the subjective determination of outcomes. Finally, Zen Buddhist meditation was not better than blood pressure checks to reduce SBP. Although the result for DBP was clinically and statistically significant, caution should be exerted as there was some heterogeneity among the studies that contributed data for this outcome.

Yoga was no better than physical exercises to reduce body weight in patients with cardiovascular disorders. When the relative effectiveness of a variety of meditation practices was assessed using indirect meta-analysis, we found that there were no significant differences between MBSR and Yoga to control anxiety symptoms in cardiovascular patients.

Topic IV. Evidence on the Role of Effect Modifiers for the Practice of Meditation

We aimed to identify the role of effect modifiers (e.g., patient and meditation characteristics) as moderators of the treatment effect measured in clinical trials of meditation practices in hypertension, other cardiovascular diseases, and substance abuse. The small number of trials per comparison and the limited data from primary studies precluded meta-regression analyses using RCT-level covariates to assess the role of specific effect modifiers for the practice of meditation. We were also unable to conduct subgroup analyses to explore differences among subgroups of patients as the trials failed to report results by the effect modifiers being considered (i.e., characteristics of the practice or patients). Therefore, we will describe the findings from the individual studies that reported data on the role of effect modifiers.

Hypertension

Of 27 trials that examined the effect of meditation practices for hypertension, only seven trials[203,205,206,209,220-222] conducted a subgroup analysis or a multiple regression analysis to explore the role of a variety of effect modifiers. A summary of the analysis is provided in Table 35.

Four studies[205,206,220,221] conducted an analysis of the role of effect modifiers on health outcomes resulting from the practice of TM®. They used multiple regression models[205,206,221] or subgroup analyses[220,222] by a variety of effect modifiers such as age,[205,206,206] gender, antihypertensive medication use,[206,220,222] income,[205] education,[205] and smoking[206] One study[209] conducted a subgroup analysis by age, gender, severity of hypertension, duration of disease, and medication use for the effects of RR. Another study[203] conducted a subgroup analysis by severity of hypertension and duration of the disease on the effects of mantra meditation and relaxation techniques. Finally, one study on a technique modeled after TM® conducted subgroup analyses of medication use,[222] and marital status.[222]

All the trials were likely to have conducted post hoc analyses as the analyses were not reported as part of the plan of analysis in the Methods sections of the studies. It is unknown whether authors of the trials decided to selectively report on the variables that showed a statistically significant positive effect.

None of the trials that provided data on effect modifiers of meditation practices for hypertension analyzed the effect of the dose of practice necessary to achieve health outcomes. Neither the role of the direction of attention during meditation nor the rhythmic aspects of the practice were explored in the studies. The trials did not provide data on how ethnicity predicts health outcomes resulting from the practice of meditation. The role of individual variables to predict success in the process of meditation (expressed as adherence or acceptance) was not explored in the trials of meditation practice and hypertension.

Table 35. Summary of the analyses of effect modifiers for achieving benefits from meditation practice for hypertension

Study, year, country	Study design, duration, followup, ITT	Intervention	Comparison groups	Type of analysis	Authors' conclusions
Aivazyan TA, 1988[203] Russia	RCT parallel 2 arms Duration: 12 mo. ITT: Yes	Mantra meditation + relaxation techniques	NT	Subgroup analysis by severity and duration of disease (post hoc)	The responders had higher BP and shorter hypertension duration than did the nonresponders
Calderon R Jr, 2000[205] United States	RCT parallel 2 arms Duration: 6 mo. ITT: NR	TM®	HE	Multiple regression analysis controlling by age, income, education. Subgroup analysis by education (post hoc)	Subjects with high school education differed significantly in magnitude of reduction in TC and LDL-C compared to those with college education Education/SES may interact with lipid response to the practice of TM®
Castillo-Richmond A, 2000[206] United States	RCT parallel 2 arms Duration: 9 mo. ITT: Yes	TM®	HE	Multiple regression analysis controlling by age, AHM use, and smoking (post hoc)	No significant differences in SBP and DBP were observed after controlling for age, AHM use, and smoking
Hager JL, 1978[209] United States	RCT parallel 2 arms Duration: 4 wk. ITT: No	RR	BF (BP)	Subgroup analysis by age, sex, severity and duration of disease, and medication use (post hoc)	There were no significant effects of age, sex, severity and duration of disease, and medication use on BP mean changes
Schneider RH, 1995[79,221,232] United States	RCT parallel 3 arms Duration: 3 mo. ITT: Yes	TM®	PMR HE	Multiple regression analysis controlling by age, sex, risk level	Both SBP and DBP significantly improved for both sexes and for high- and low-risk levels

AHM = antihypertensive medication; AT = autogenic training; BE = breathing exercises; BF = biofeedback; BHT = borderline hypertension; BP = blood pressure; CMBT = contemplative meditation with breathing techniques; DBP = diastolic blood pressure; HE = health education; HT = hypertension; ITT = intention-to-treat;; LDL-C = low-density lipoprotein cholesterol; mo. = months; NR = not reported; NRCT = nonrandomized clinical trial; NS = not specified; NT = no treatment; PLB = placebo; PMR = progressive muscle relaxation; RR = relaxation response; SBP = systolic blood pressure; TM® = Transcendental Meditation®; UC = usual care; wk = weeks; WL = waiting list; yr = year

Table 35. Summary of the analysis of effect modifiers for achieving benefits from meditation practice for hypertension (continued)

Study, year, country	Study design, duration, followup, ITT	Intervention	Comparison groups	Type of analysis	Authors' conclusions
Schneider RH, 2005[220] United States	RCT parallel 3 arms Duration: 1 yr. ITT: Yes	TM®	PMR HE	Subgroup analysis by sex (post hoc)	The change of SBP in women was not significantly greater than in men There was no significant overall difference in DBP. Compared to the other groups, women in the TM® group decreased more on both SBP and DBP
Seer P, 1980[222] New Zealand	RCT parallel 3 arms Duration: 3 mo. ITT: NR	SRELAX (technique modeled after TM®)	PLB WL	Subgroup analysis by sex, marital status, use of AHM in the past, duration of disease (post hoc)	Responders had a significantly longer hypertension history Sex, marital status, and use of hypertensive medication in the past did not affect outcomes

Cardiovascular Diseases

Of 21 trials on the effects of meditation practice on cardiovascular (CV) diseases, only two trials[234,239] conducted subgroup or multiple regression analyses to explore the role of effect modifiers on achieving potential benefits of meditation practice. A summary of the analysis is provided in Table 36.

Using a multiple regression model, one trial[234] explored whether age, education, medication use, and diet restrictions were predictors of the effectiveness of RR in patients with CV diseases. Another trial[239] conducted a subgroup analysis by type of condition, (i.e., patients with angina versus patients with risk factors) of the effect of an intervention that combined Yoga and dietary changes. Both trials likely conducted post hoc analyses as they were not reported as part of a plan of analysis in the Methods sections of the studies. It is unknown whether there is an outcome selection bias in the reporting of variables that were included in the analysis. None of the trials explored the effect of the dose practice necessary to achieve health outcomes, the role of direction of attention during meditation, or the rhythmic aspects of the practice. The trials did not provide data on whether ethnicity or other individual variables affect associated health outcomes or whether these variables can be used to predict the successful practice of meditation.

Table 36. Summary of the analyses of effect modifiers for achieving benefits from meditation practice for cardiovascular diseases

Study, year, country	Study design, duration, followup, ITT	Intervention	Comparison groups	Type of analysis	Authors' conclusions
Chang BH, 2005[234] United States	RCT parallel 3 arms Duration: 19 wk. ITT: Yes	RR	HE UC (NS)	Multiple regression analysis controlling by age, education, medication use, and diet restrictions (post hoc)	No significant differences were observed in the adjusted change values of VO_2 max, total exercise time, and exercise capacity
Mahajan AS, 1999[239] India	RCT parallel 2 arms Duration: 14 wk. ITT: NR	Yoga + diet changes	Exercise + diet changes	Subgroup analysis by condition (risk factor group, angina group)	Subjects with coronary risk factors had significant decreases in body weight, TC, LDL-C, and increase in HDL-C Subjects with angina had a decrease in body weight, TG and HDL-C increased Changes in agina patients were acute (4 wk.) while those in subjects with subject factors lasted 10 wk.

CAD = coronary artery disease; HDL-C = high-density lipoprotein cholesterol; HE = health education; ITT = intention-to-treat; LDL-C = low-density lipoprotein cholesterol; NS = not specified; TC = total cholesterol; TG = triglycerides; VO_2 max = maximum oxygen consumption; UC = usual care; wk. = weeks

Substance Abuse

Of 17 trials investigating the effect of meditation practices on substance abuse disorders, only 4 trials[264,267,268,274] conducted subgroup or multiple regression analyses to explore the role of a variety of effect modifiers on achieving potential benefits of meditation practices. A summary of the analysis of effect modifiers is provided in Table 37.

The trials did not report on effect of variables such as age, gender, or ethnicity. One trial on the effect of RR that incorporated PMR and cognitive restructuring[268] conducted a subgroup analysis by level of drinking and level of social support received. The effect of other patient characteristics on the outcomes achieved after practicing meditation were not reported in the studies. One study[267] conducted a subgroup analysis by regularity of practice of TM®. A third trial, on a meditation practice not further specified,[274] conducted a subgroup analysis by participation in Alcoholic Anonymous groups. All the trials seemed to use exploratory post hoc analyses that were intended to be hypothesis generating. It is unknown whether authors of the trials selectively reported the variables that showed a statistically significant positive effect. The fourth trial[264] conducted a subgroup analysis on differences in outcomes between high compliers and noncompliers.

None of the trials that provided data on effect modifiers of meditation practices for substance abuse analyzed the effect of the dose of practice necessary to achieve health outcomes, the role of direction of attention during meditation, or the rhythmic aspects of the practice.

Table 37. Summary of the analysis of effect modifiers for achieving benefits from meditation practice for substance abuse

Study, year, country	Study design, duration, followup, ITT	Intervention	Comparison groups	Type of analysis	Authors' conclusions
Murphy TJ, 1986[264] United States	RCT parallel 3 arms Duration: 8 wk. ITT: NR	CSM	Exercise NT	Subgroup analysis by compliance (post hoc)	Statistically significant differences between high compliers and noncompliers in ethanol consumption and in VO_2 gains among meditators
Ramirez J, 1990[267] United States	RCT parallel 2 arms Duration: NR ITT: NR	TM®	Control (NS)	Subgroup analysis by regularity of practice (post hoc)	Regular TM® practitioners showed a significantly greater increase in a measure of self-concept No differences between regular versus irregular TM® practitioners were found for measures of internality-externality
Rohsenow DJ, 1985[268] United States	RCT parallel 2 arms Duration: 6 mo. ITT: NR	RR + PMR + cognitive restructuring	Control (NS)	Subgroup analysis by level of drinking and social support (post hoc)	Participants with heavier drinking behavior and greater social support at baseline obtained significantly greater decreases in alcohol consumption
Wong MR, 1981[274] United States	NRCT parallel 2 arms Duration: 6 mo. ITT: NR	Meditation practice (NS)	Relaxation	Subgroup analysis by participation in AA (post hoc)	Participants in the meditation group that took part in AA showed greater improvements in measures of impulsivity

AA = Alcoholics Anonymous; CSM = clinically standardized meditation; ITT = intention-to-treat; mo = months; NRCT = nonrandomized controlled trial; NR = not reported; NS = not specified; PMR = progressive muscle relaxation; RR = relaxation response; TM® = Transcendental Meditation®; VO_2 = oxygen consumption; wk = weeks

Summary of the Results

The role of effect modifiers such as characteristics of the practice or patient characteristics has so far been neglected in primary research on the effects of meditation practices. Therefore, we were unable to use a linear meta-regression procedure to explore any interactions between patient characteristics or characteristics of the practice and the magnitude of the overall effect of meditation practices for hypertension, cardiovascular diseases, and substance abuse. Individual studies (seven trials on hypertension, two on cardiovascular diseases, and four on substance abuse) conducted subgroup or multiple regression analysis; however, no analyses were reported a priori in the "Methods" sections of the studies. No conclusions on the role of effect modifiers can be drawn from the analysis of the individual studies. Individual patient data are required to appropriately examine this issue.

Topic V. Evidence on the Physiological and Neuropsychological Effects of Meditation Practices

Three hundred and eleven intervention studies provided evidence on 1,323 measures of the physiological and neuropsychological effects of meditation practices. Physiological outcomes only were reported in 253 studies, cognitive and neuropsychological outcomes only in 34 studies, and both physiological and neuropsychological outcomes were reported in 24 studies. The main characteristics and methodological quality of the studies included in topic V are summarized in Tables I1 to I3 in Appendix I.*

General Characteristics

Of the 311 studies providing data for this topic, 54 percent (n = 167) were RCTs, 21 percent (n = 65) were NRCTs, and 25 percent (n = 79) used a before-and-after design. The studies that examined the physiological and neuropsychological effects of meditation practices were composed of 110 trials on Yoga, 47 on TM®, 38 on Tai Chi, 34 on RR, 17 on mantra meditation not further described, 15 on Qi Gong, 12 on MBSR, 10 on Zen Buddhist meditation, 9 on meditation practices not further described, 8 on MM, 4 on CSM, 3 on Acem meditation, and 2 each on MBCT and Vipassana meditation. The studies were published between 1956 and 2005 (median year of publication, 1995; IQR, 1986 to 2002). Most of the studies (88 percent, n = 274) were published as journal articles. Seven percent (n = 22) were theses or dissertations, four percent (n = 13) were abstracts, and one percent (n = 2) were published as research letters. Fifty percent of the studies were conducted in North America (n = 155), followed by Asia (34 percent, n = 106), Europe (11 percent, n = 35), Australasia (three percent, n = 10), and other regions (two percent, n = 5).

Overall Methodological Quality

Randomized controlled trials. The methodological quality of the RCTs was analyzed by the individual components of the Jadad scale. Overall, the methodological quality of the 167 RCTs was poor (median Jadad score 2/5; IQR, 1 to 2). Thirteen percent (n = 21) of the RCTs were considered high quality (i.e., Jadad score of 3 or more). Only one study[168] obtained a score of 4 and no study obtained a perfect score of 5. The remaining 146 RCTs had a high risk of bias.

We found that only 32 (19 percent) of the studies described the randomization procedure. Of these 32 studies, 24 described an adequate procedure to randomize study participants to treatment groups, and 8 described inadequate or unreliable methods of randomization that might have introduced imbalances between group characteristics and jeopardized the estimates of the overall treatment effect.

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

The majority of RCTs (97 percent, n = 162) did not use double blinding to conceal the identity of the interventions. Four studies (two percent) were reported as double-blind trials. Finally, 52 percent (n = 86) of the RCTs provided a description of withdrawals and dropouts from the study.

Adequate concealment of treatment allocation was reported in five percent (n = 8) of the RCTs and was reported but considered inadequate in one percent (n = 2). The remaining RCTs (94 percent, n = 157) failed to describe how they concealed the allocation of subjects to the interventions under study. Finally, the source of funding was disclosed in 46 percent (n = 76) of the RCTs. A summary of the methodological quality of RCTs is presented in Table 38.

Table 38. Methodological quality of RCTs on the physiological and neuropsychological effects of meditation practices

Quality components	N studies (%)
Randomization	167 (100)
Double blinding	4 (2.4)
Appropriate randomization	24 (14.3)
Appropriate double blinding	0 (0)
Description withdrawals	86 (51.5)
Total Jadad score (max 5); Median (IQR)	2 (1,2)
Number of high quality RCTs (Jadad scores ≥3)	22 (13.1)
Appropriate concealment of allocation	8 (4.8)
Funding reported	76 (45.5)

IQR = interquartile range; RCT = randomized controlled trial

Nonrandomized controlled trials. Overall, the quality of the 65 NRCTs was low (median modified-Jadad score 0/3; IQR, 0 to 1). Thirty-seven percent of the studies (n = 24) received one point out of three for the individual components of the Jadad scale, in all cases for a description of withdrawals or dropouts. The remaining 63 percent did not receive any points. No studies described themselves as double blind. Finally, the source of funding was reported in 32 percent (n = 21) of the NRCTs. A summary of the methodological quality of NRCTs is presented in Table 39.

Table 39. Methodological quality of NRCTs on the physiological and neuropsychological effects of meditation practices

Quality components	N studies (%)
Double blinding	...
Appropriate double blinding	...
Description withdrawals	24 (36.9)
Funding reported	21 (32.3)

NRCT = nonrandomized controlled trials

Before-and-after studies. The quality of the 79 before-and-after studies was low. Only four percent (n = 3) of studies contained a sample population that could be considered representative of the target population. The blinding of outcome assessors to the intervention and assessment was described in 3 percent (n = 2) of studies, the number of study withdrawals in 15 percent (n = 12) and reasons for study withdrawals in 8 percent (n = 6). However, 94 percent of studies (n = 74) reported using the same method of outcome assessment for the pre- and post-intervention periods. Funding source was disclosed in 32 percent (n = 25) of studies. A summary of the methodological quality of before-and-after studies is provided in Table 40.

Table 40. Methodological quality of before-and-after studies on the physiological and neuropsychological effects of meditation practices

Quality components	N studies (%)
Study population representative of the target population	3 (3.8)
Method of outcome assessment is the same for pre- and post- intervention periods	74 (93.7)
Outcome assessors were blind to intervention and assessment period	2 (2.5)
Description of the number of study withdrawals	12 (15.2)
Description of the reasons for study withdrawal	6 (7.6)
Funding reported	25 (31.6)

Outcome Measures

The ten most commonly reported physiological outcome measures were (1) cardiovascular functioning such as heart rate or blood pressure (169 studies), (2) pulmonary functioning FEV_1 and FVC (67 studies), (3) periferal nerve tests such as skin conductance (40 studies), (4) adrenocortical functioning such as cortisol and adrenaline levels (26 studies), (5) lipoprotein levels (25 studies), (6) EMG (23 studies), (7) carbohydrate metabolism such as glucose and insulin levels (18 studies), (8) brain electrophysiology such as EEG patterns (17 studies), (9) metabolic product levels such as lactic acid level (16 studies), and (10) CNS hormone and blood composition (11 studies each).

The ten most commonly reported cognitive/neuropsychological outcomes were measures of (1) attention (19 studies), (2) memory (12 studies), (3) perception (12 studies), (4) other cognitive measures such as overall cognitive functioning (11 studies), (5) reasoning (10 studies), (6) sensorimotor functioning (10 studies), (7) language (7 studies), (8) creativity (4 studies), (9) intelligence (4 studies), and (10) spatial ability (4 studies). Table I6 in Appendix I contains the complete list of reported outcome measures and their associated studies.*

Results of Quantitative Analysis

To summarize the results of the physiological and neuropsychological effects of meditation practices, we combined study results when two or more studies agreed on the type of meditation practice, comparison group, outcomes assessed, and had usable outcome data. Table 41 summarizes the type of meditation practice, comparison group, and outcomes that were available for direct meta-analyses. Meta-analyses of physiological and neuropsychological outcomes on populations with hypertension, cardiovascular diseases or substance abuse have been reported in topic III.

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

Outcomes on the physiological and neuropsychological effects of meditation practices for which data could be combined into a direct meta-analysis were provided by 53 unique studies for a total of 15 comparisons examining five meditation techniques: TM®, RR, Yoga, Tai Chi, and Qi Gong. The remaining 258 studies were not suitable for direct meta-analysis because no more than one study was available for pooling. Yoga interventions provided the most studies for comparison (28 studies), followed by TM® (10 studies), Tai Chi (7 studies), RR (6 studies), and Qi Gong (2 studies). The trials were published between 1974 and 2005 (median year of publication, 1993; IQR, 1989 to 2001).

Of the 53 intervention studies included for meta-analysis, 20 used an RCT design, 8 used an NRCT design, and 25 were before-and-after studies. The majority of studies (n = 43) examined outcomes in healthy populations (athletes, college and university students, workers, military, prisoners, and elderly). The remaining studies examined individuals with hypertension (6 studies) and type II DM (4 studies). The main characteristics and conclusions of the individual studies included in the meta-analyses are provided in Appendix J.*

Table 41. Summary of outcomes by meditation practice by comparison group by population included in meta-analyses of physiological and neuropsychological effects of meditation practices

Intervention	Comparator	Population	Outcome	No. of studies
TM®	No control	Healthy	BP change (SBP)	2
		Healthy	BP change (DBP)	2
	NT	Healthy	BP change (SBP)	3
		Healthy	BP change (DBP)	3
		Healthy	Cholesterol level	3
		Healthy	Verbal fluency	2
	WL	Healthy	HR	2
		Healthy	BP change (SBP)	2
		Healthy	BP change (DBP)	2
RR	BF	Healthy	Muscle tension	2
	Rest	Healthy	HR	3
		Healthy	BP change (SBP)	2
		Healthy	BP change (DBP)	2
Yoga	Exercise	Healthy	BP change (DBP)	2
		Healthy	HR	2
	Free breathing	Healthy	Verbal ability	2
		Healthy	Spatial ability	2
	Medication	Healthy	VO_2	2
		Type II DM	Fasting blood glucose	2
	No control	Healthy	HR	7
		Hypertension	HR	2
		Healthy	BP change (SBP)	5
		Healthy	BP change (DBP)	5
		Healthy	Respiratory rate	3
		Healthy	Galvanic skin resistance	2
		Type II DM	Fasting glucose	2

*Appendixes and evidence tables cited in this report are provided electronically at http://www.ahrq.gov/clinic/tp/medittp.htm

BF = biofeedback; BP = blood pressure; DBP = diastolic blood pressure, DM = diabetes mellitus; HE = health education; HR = heart rate; NT = no treatment; RR = Relaxation Response; SBP = systolic blood pressure, ULNB = unilateral left nostril breathing; URNB = unilateral right nostril breathing; WL = wait list

Table 41. Summary of outcomes by meditation practice by comparison group by population included in meta-analyses of physiological and neuropsychological effects of meditation practices (continued)

Intervention	Comparator	Population	Outcome	No. of studies
Yoga (continued)	No control (continued)	Healthy	Fasting glucose	2
		Healthy	Total cholesterol	2
		Healthy	Breath holding time (inspiration)	3
		Healthy	Breath holding time (expiration)	4
		Healthy	Auditory reaction time	2
		Healthy	Visual reaction time	2
		Healthy	Intraocular pressure	2
	NT	Healthy	BP change (SBP)	2
	URNB	Healthy	HR	2
Tai Chi	Exercise	Healthy	BP change (SBP)	2
		Healthy	BP change (DBP)	2
	No control	Healthy	HR	2
		Healthy	BP change (SBP)	2
		Healthy	BP change (DBP)	2
	NT	Healthy	HR	2
		Healthy	BP change (SBP)	3
		Healthy	BP change (DBP)	3
Qi Gong	No control	Healthy	HR	2

Methodological Quality of Included Studies

Intervention studies. The median Jadad score for the 20 RCTs was 2/5 (IQR, 1 to 2) (Table 40). No trials were described as double blind and no studies were considered to have employed adequate concealment of treatment allocation. A description of withdrawals and dropouts was provided in 10 of the trials.[278-287] Only five RCTs reported the source of funding.[281,282,285,286,288]

The median Jadad score for the eight NRCTs was 1/3 (IQR, 0 to 1). No NRCTs described themselves as double blind (blinding of participant and outcome assessor). Five trials provided a description of withdrawals and dropouts.[289-293] Three NRCTs reported the source of funding[180,181,293] (Table 42).

Before-and-after studies. The overall methodological quality of the 25 included before-and-after studies was low (Table 43). Only one study[294] was considered to have a study population representative of the population of interest. Twenty-five studies employed the same method of outcome assessment for pre and post periods; no studies reported blinding of outcome assessors. Two studies[295,296] provided a description of withdrawals or dropouts; no studies provided reasons for withdrawals. Nine studies reported their source of funding.[294,296-303]

Table 42. Methodological quality of RCTs and NRCTs included in meta-analyses for physiological and neuropsychological effects of meditation practices

Study	Meditation practice	Randomization: Stated	Randomization: Method described	Double blinding: Stated	Double blinding: Method described	Description of withdrawals and dropouts	Overall Jadad score	Allocation concealment	Report of funding
Abrams AI, 1978[289]	TM®	No	NA	No	NA	Yes	1	Unclear	No
Agrawal RP, 2003[278]	Yoga	Yes	Unclear	No	NA	Yes	2	Inadequate	No
Alexander CN, 1991[279]	TM®	Yes	Unclear	No	NA	Yes	2	Inadequate	No
Bahrke MS, 1978[304]	RR	Yes	Unclear	No	NA	No	1	Inadequate	No
Block RA, 1989[177]	Yoga (UNB)	Yes	Unclear	No	NA	No	1	Inadequate	No
Blumenthal JA, 1991[280]	Yoga	Yes	Unclear	No	NA	Yes	2	Inadequate	No
Bose S, 1987[305]	Yoga (Shavasana)	Yes	Unclear	No	NA	No	1	Inadequate	No
Bowman AJ, 1997[281]	Yoga	Yes	Unclear	No	NA	Yes	2	Inadequate	Yes
Broota A, 1995[204]	Yoga (Shavasana)	Yes	Unclear	No	NA	No	1	Inadequate	No
Chen WW, 1997[290]	Tai Chi	No	NA	No	NA	Yes	1	Unclear	No
Cooper MJ, 1990[291]	TM®	No	NA	No	NA	Yes	1	Unclear	No
Cuthbert B, 1981[306]b	RR	No	NA	No	NA	No	0	Unclear	No
De Armond DL, 1996[292]	TM®	No	NA	No	NA	Yes	1	Unclear	No
Fields JZ, 2002[282]	TM® + herbal food supplements + diet + Yoga asanas	Yes	Adequate	No	NA	Yes	3	Inadequate	Yes
Hoffman JW, 1982[283]	RR	Yes	Unclear	No	NA	Yes	2	Inadequate	No
Jin P, 1992[307]	Tai Chi	Yes	Unclear	No	NA	No	1	Inadequate	No

NA = not applicable; RR = Relaxation Response; TM® = Transcendental Meditation®; UNB = unilateral nostril breathing

Table 42. Methodological quality of RCTs and NRCTs included in meta-analyses for physiological and neuropsychological effects of meditation practices (continued)

Study	Meditation practice	Randomization		Double blinding		Description of withdrawals and dropouts	Overall Jadad score	Allocation concealment	Report of funding
		Stated	Method described	Stated	Method described				
Mohan SM, 2002[180]	Yoga (UNB)	No	NA	No	NA	No	0	Unclear	Yes
Monro R, 1992[308]	Yoga	Yes	Adequate	No	NA	No	2	Inadequate	No
Peters RK, 1977[284]	RR	Yes	Adequate	No	NA	Yes	3	Inadequate	No
Pollak MH, 1979[288]	RR	Yes	Unclear	No	NA	No	1	Inadequate	Yes
Reddy KM, 1990[309]	TM®	Yes	Unclear	No	NA	No	1	Inadequate	No
Sanders B, 1994[181]	Yoga (UNB)	No	NA	No	NA	No	0	Unclear	Yes
Sun WY, 1996[285]	Tai Chi	Yes	Unclear	No	NA	Yes	2	Inadequate	Yes
Telles S, 1994[140]	Yoga (UNB)	Yes	Unclear	No	NA	No	1	Inadequate	No
Thornton EW, 2004[286]	Tai Chi	Yes	Unclear	No	NA	Yes	2	Inadequate	Yes
Travis FT, 1990[293]	TM®	No	NA	No	NA	Yes	1	Unclear	Yes
Young DR, 1999[287]	Tai Chi	Yes	Unclear	No	NA	Yes	3	Inadequate	No
Zaichkowsky LD, 1978[191]	RR	Yes	Adequate	No	NA	No	1	Inadequate	No

Table 43. Methodological quality of before-and-after studies included in meta-analyses for physiological and neuropsychological effects of meditation practices

Study	Meditation practice	Study population representative	Outcome method same for pre and post periods	Blinding of outcome assessors	Description of withdrawals/ dropouts	Reasons for withdrawal	Report of funding
Agarwal BL, 1990[295]	TM®	No	Yes	No	Yes	No	No
Anantharaman RN, 1984[310]	Yoga (asanas + pranayama)	No	Yes	No	No	No	No
Benson H, 1974[311]	TM®	No	Unsure	No	No	No	No
Bhargava R 1988[312]	Yoga (pranayamas)	No	Yes	No	No	No	No
Chen JC, 2004[297]	Yoga (UNB)	No	Yes	No	No	No	Yes
Damodaran A, 2002[294]	Yoga (asanas + pranayamas)	Yes	Yes	No	No	No	Yes
Jain SC, 1993[298]	Yoga	No	Yes	No	No	No	Yes
Jones AY, 2005[296]	Tai Chi	No	Yes	No	Yes	No	Yes
Jones BM, 2001[299]	Qi Gong	No	No	No	No	No	Yes
Joseph S, 1981[313]	Yoga (prayer + asanas + pranayama + meditation)	No	Yes	No	No	No	No
Joshi LN, 1992[314]	Yoga (pranayamas)	No	Yes	No	No	No	No
Kocer I, 2002[315]	Yoga (UNB)	No	Yes	No	No	No	No
Lim YA, 1993[316]	Qi Gong	No	Yes	No	No	No	No
Liu S, 1996[317]	Tai Chi	No	Yes	No	No	No	No
Madanmohan, 1992[300]	Yoga	No	Yes	No	No	No	Yes

RR = Relaxation Response; TM® = Transcendental Meditation®; UNB = unilateral nostril breathing

Table 43. Methodological quality of before-and-after studies included in meta-analysis for physiological and neuropsychological effects of meditation practices (continued)

Study	Meditation practice	Study population representative	Outcome method same for pre and post periods	Blinding of outcome assessors	Description of withdrawals/ dropouts	Reasons for withdrawal	Report of funding
Malathi A, 1989[318]	Yoga (asanas + pranayamas)	No	Yes	No	No	No	No
Manjunatha S, 2005[301]	Yoga	No	Yes	No	No	No	Yes
Pollack AA, 1977[319]	TM®	No	Yes	No	No	No	No
Raju PS, 1986[320]	Yoga (asanas + pranayamas)	No	Yes	No	No	No	No
Schmidt TFH, 1994[302]	Yoga + meditation + vegetarian diet	No	Yes	No	No	No	Yes
Singh S, 2004[321]	Yoga (asanas + pranayamas)	No	Yes	No	No	No	No
Sung BH, 2002[322]	Yoga	No	Yes	No	No	No	No
Telles S, 1993[323]	Yoga (asanas + pranayama + mantra meditation + lectures)	No	Yes	No	No	No	No
Telles S, 1993[83]	Raja Yoga	No	Yes	No	No	No	No
Vijayalakshmi P, 2004[303]	Yoga (asanas + pranayamas)	No	Yes	No	No	No	Yes

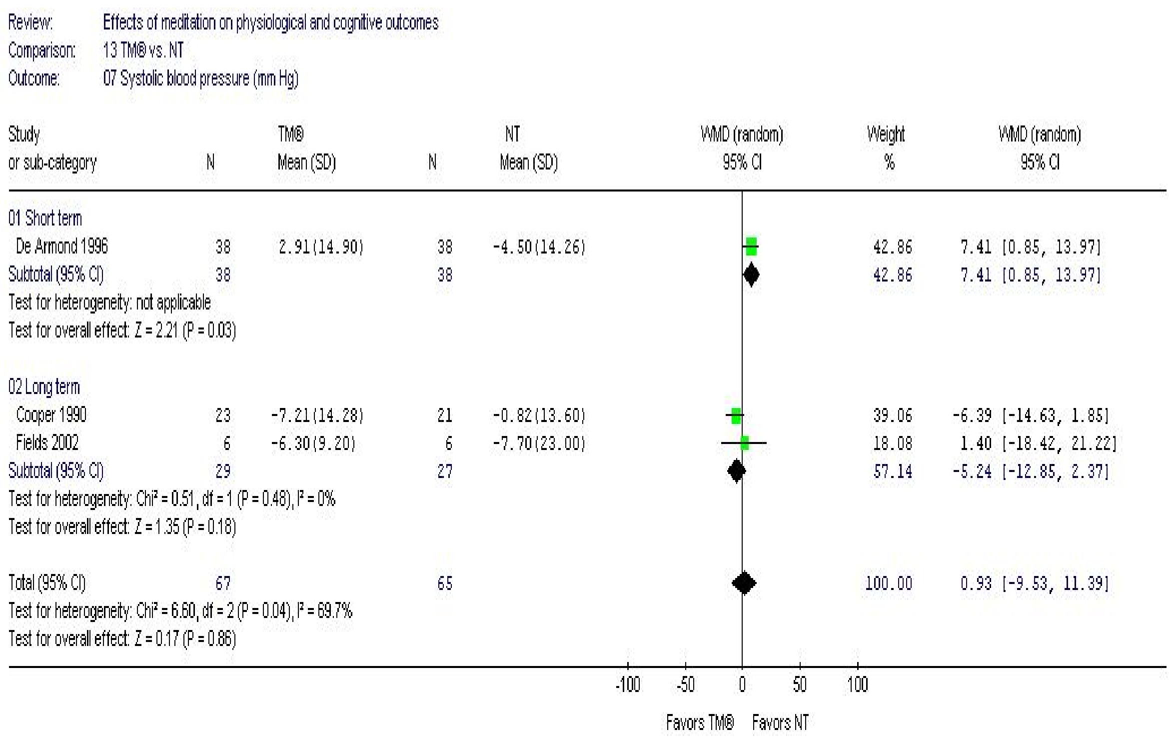
Transcendental Meditation®

Ten studies assessing the physiological and neuropsychological effects of TM® were identified for meta-analysis: three RCTs,[279,282,324] four NRCTs,[289,291-293] and three before-and-after studies.[295,311,319] Among the controlled studies, five studies compared TM® versus NT,[279,282,291-293] and two compared TM® versus WL.[289,309]

TM® versus NT

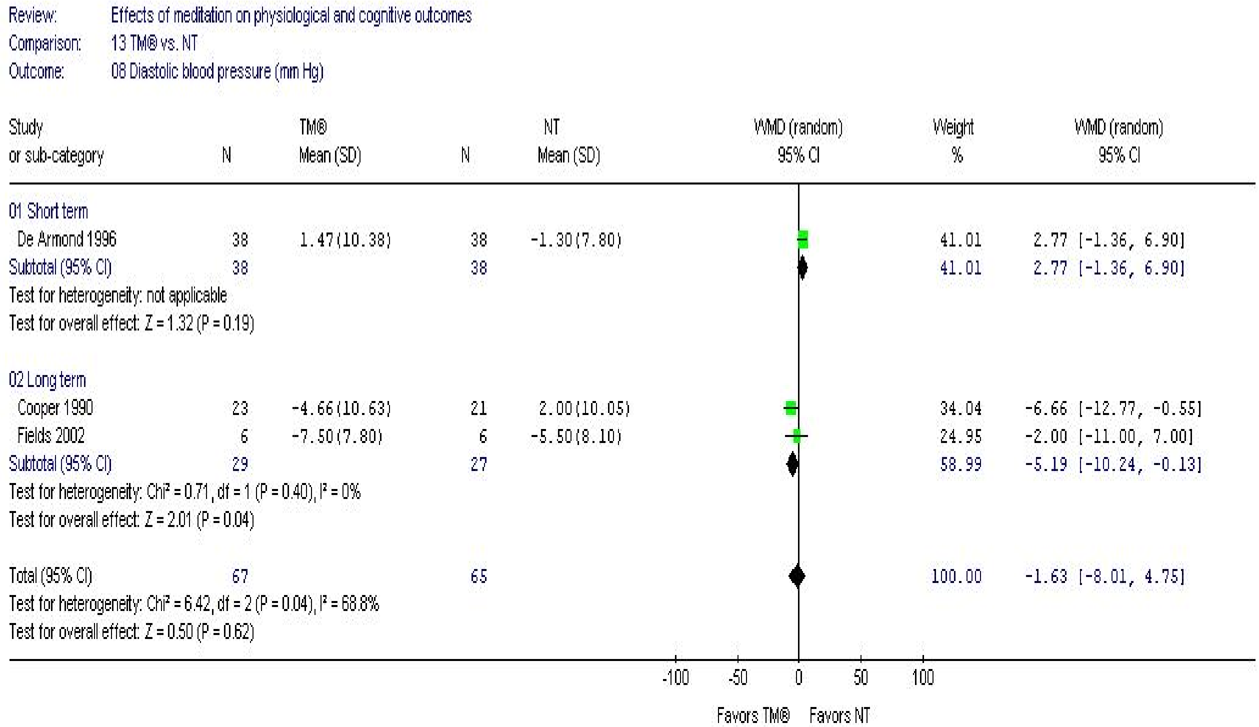
Blood pressure. Three studies[282,291,292] totaling 132 participants (TM® = 67, NT = 65) provided data for a meta-analysis on the effects of TM® on blood pressure in healthy populations (Figure 28). The combined estimate of changes in SBP (mm Hg) showed a small, but nonsignificant improvement (reduction) in favor of NT (WMD = 0.93; 95% CI, -9.53 to 11.39). There was evidence of high heterogeneity among the studies regarding the mean change in SBP ($p = 0.04$, $I^2 = 69.7$ percent). The studies differed in duration with two studies being long-term[282,291] (10 and 12 months, respectively) and the remaining study[292] being short-term (3 months). A subgroup analysis indicated that for the long-term studies there was a nonsignificant improvement (reduction) in SBP favoring TM® (WMD = -5.24, 95% CI, -12.85, 2.37); for the short-term study, there was a statistically significant improvement favoring NT (Figure 28).

Figure 28. Meta-analysis of the effect of TM® versus NT on SBP



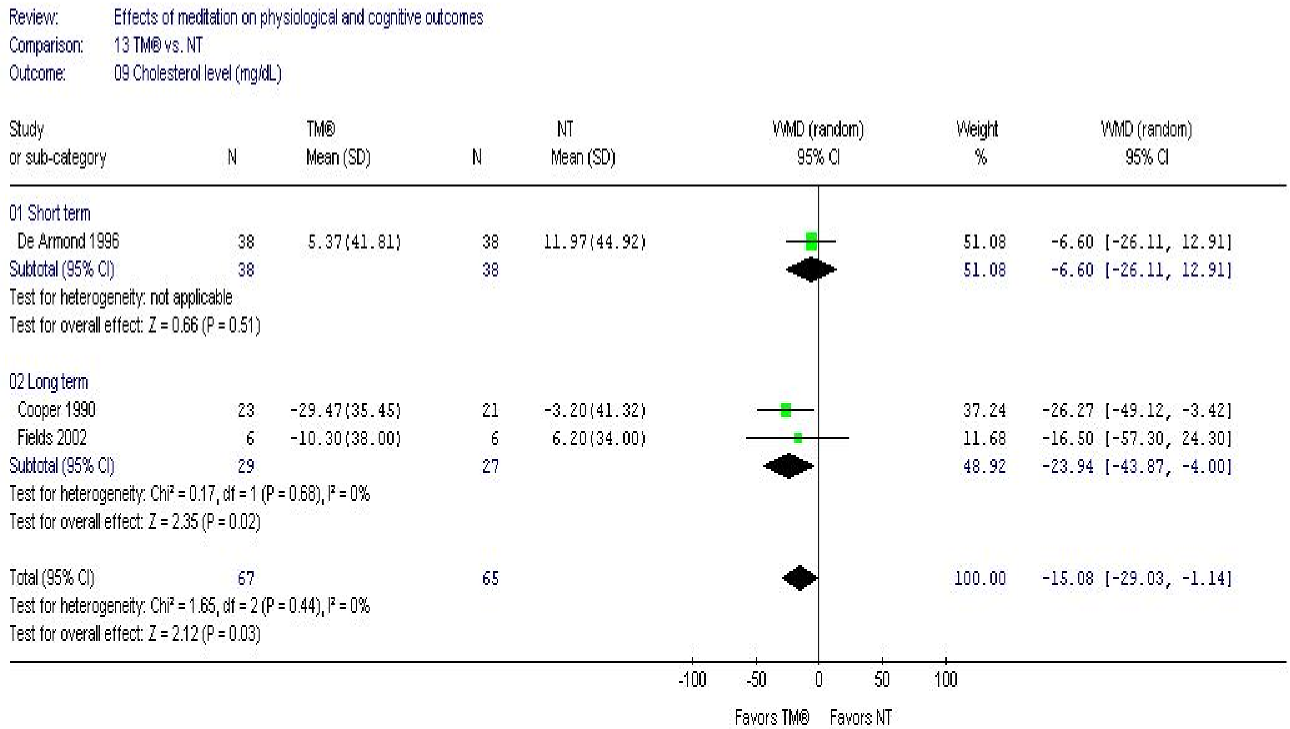
The combined estimate of changes in DBP (mm Hg) indicated a small, but nonsignificant improvement (reduction) in favor of TM® (WMD = -1.63, 95% CI, -8.01 to 4.75) (Figure 29). There was evidence of high heterogeneity among the studies regarding the mean change in DBP ($p = 0.04$, $I^2 = 68.8$ percent). As noted above, the studies differed in duration. A subgroup analysis indicated a statistically and clinically significant reduction in DBP in favor of TM® (WMD = -5.19, 95% CI, -10.24 to -0.13) in the long-term studies (Figure 29).

Figure 29. Meta-analysis of the effect of TM® versus NT on DBP



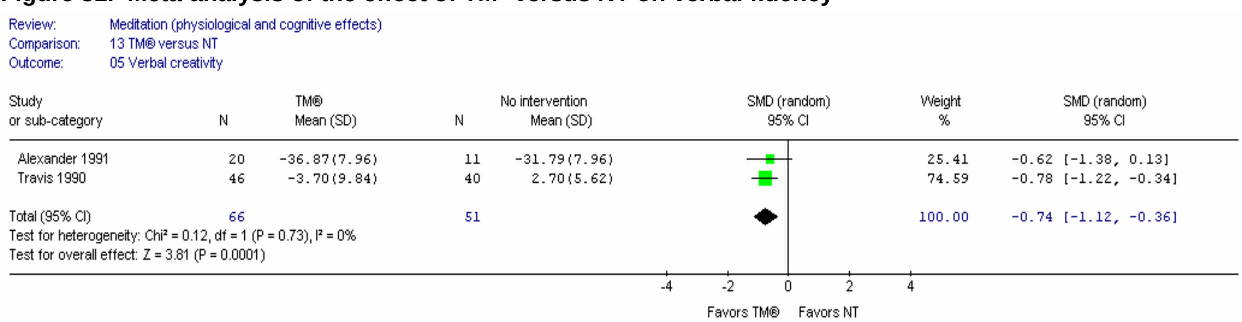
Cholesterol level. Three studies[282,291,292] totaling 132 participants (TM® = 67, Nt = 65) provided data on the effects of TM® on LDL-C levels in healthy populations. The combined estimate of changes in LDL-C level (mg/dL) indicated a small, nonsignificant improvement (reduction) in favor of TM® (WMD = -15.08; 95% CI, -29.03 to -1.14). The results for the trials were homogeneous ($p = 0.44$, $I^2 = 0$ percent). However, because of the difference in duration of the studies noted above (two were long-term[282,291] and one was short-term[292]), we conducted a subgroup analysis by duration of study (Figure 30). The long-term studies indicated a statistically significant improvement (reduction) in favor of TM® (WMD = -23.94; 95% CI, -43.87 to -4.00).

Figure 30. Meta-analysis of the effect of TM® versus NT on cholesterol level



Verbal fluency. Two studies[279,293] totaling 117 participants (TM® = 66, NT = 51) provided data on the effects of TM® on verbal creativity in healthy populations (Figure 31). The combined estimate of changes in measures of verbal fluency showed a large, significant improvement (increase) in favor of TM® (SMD = -0.74; 95% CI, -1.12 to -0.36). The results of the combined studies were homogeneous (p = 0.73, I^2 = 0 percent).

Figure 31. Meta-analysis of the effect of TM® versus NT on verbal fluency



TM® (no control)

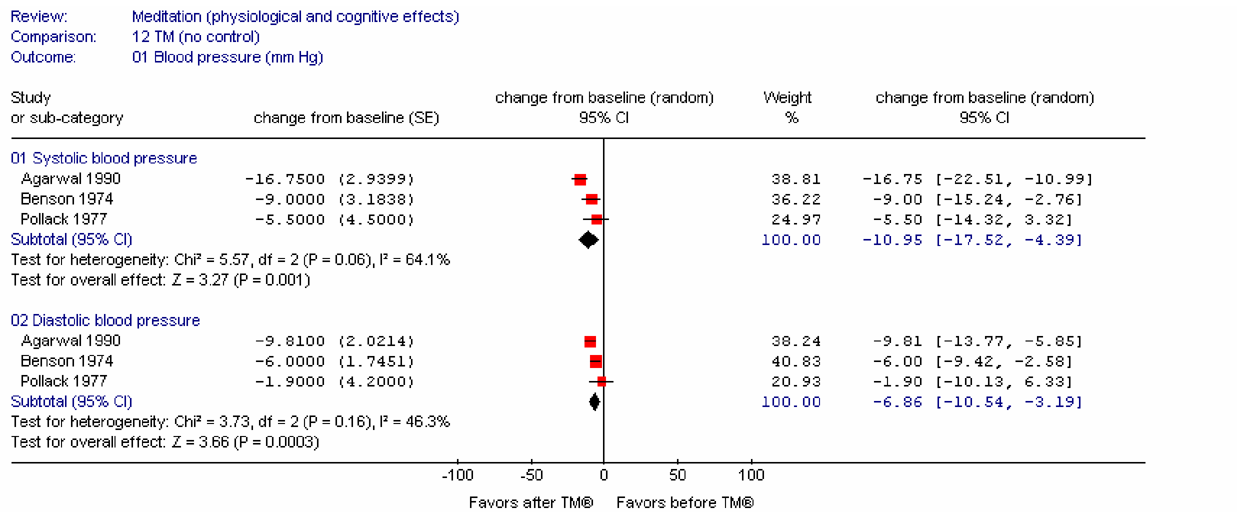
Blood pressure. Three before-and-after studies[295,311,319] totaling 58 participants provided data on the effect of TM® on blood pressure (mm Hg) in hypertensive populations (Figure 32). The combined estimate of changes in SBP indicated a statistically and clinically significant improvement (reduction) favoring TM® (change from baseline = -10.95; 95% CI, -17.52 to -4.39). There was substantial heterogeneity in the study results (p = 0.16; I^2 = 64.1 percent).

The combined estimate of changes in DBP also indicated a statistically and clinically significant improvement (reduction) favoring TM® (change from baseline = -6.86; 95% CI, -

10.54 to -3.19). There was moderate heterogeneity in the study results for DBP (p = 0.16; I^2 = 46.3 percent).

All three studies were of low methodological quality; moreover, the potential biases inherent in the before-and-after design may be responsible for the variability of results. Similar interventions, durations (not reported by Benson[311]), and study populations were used in the three studies. Though all three studies examined hypertensive patients, the baseline measures suggest that the DBP of participants in the Benson[311] study (mean DBP 94 ± 9 mm Hg) was lower upon entrance to the trial than the other two studies (minimum 90 mm Hg).

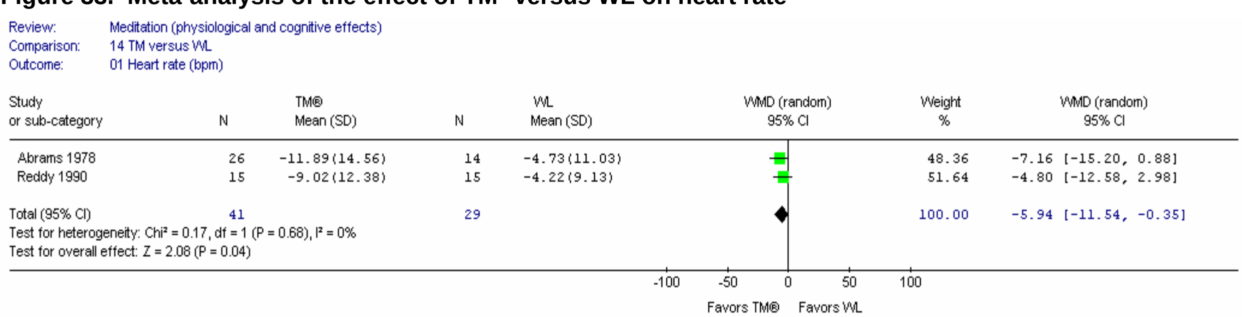
Figure 32. Meta-analysis of the effect of TM® (no control) on blood pressure



TM® versus WL

Heart rate. Two studies[289,309] totaling 70 participants (TM® = 41, WL = 29) provided data on the effects of TM® on heart rate (bpm) in healthy populations (Figure 33). The combined estimate of changes in heart rate showed small, significant improvement (reduction) favoring TM® (WMD = -5.94; 95% CI, -11.54 to -0.35). The trial results were homogeneous (p = 0.73, I^2 = 0 percent).

Figure 33. Meta-analysis of the effect of TM® versus WL on heart rate

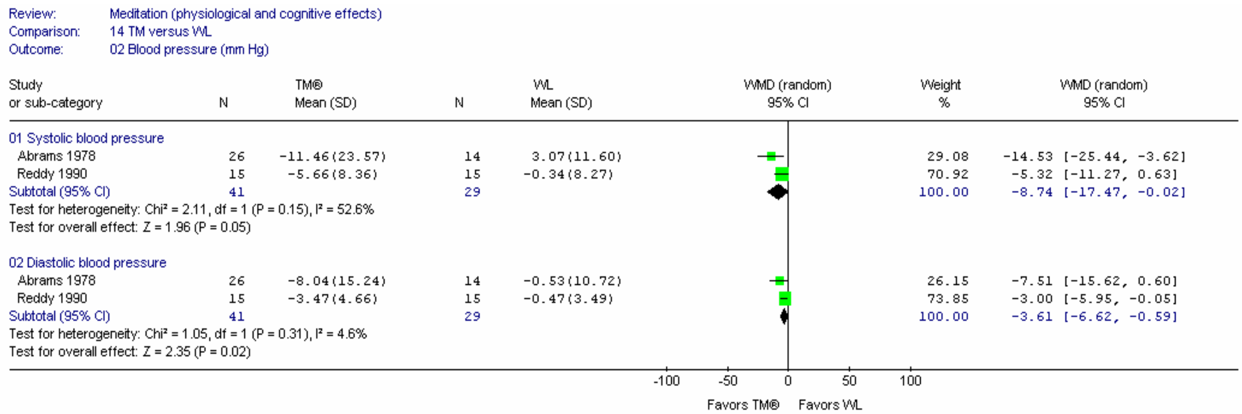


Blood pressure. The same two studies[289,309] provided data on the effects of TM® on blood pressure in healthy populations (Figure 34). The combined estimate of changes in SBP (mm Hg) showed a small, significant improvement (reduction) favoring TM® (WMD = -8.74; 95% CI, -

17.47 to -0.02). There was moderate heterogeneity in the study results ($p = 0.15$; $I^2 = 52.6$ percent). It is unclear what clinical differences among the study participants are responsible for the heterogeneity of this outcome.

The combined estimate of changes in DBP (mm Hg) also showed a small, significant improvement (reduction) favoring TM® (WMD = -3.61; 95% CI, -6.62 to -0.59). There was little heterogeneity in the study results ($p = 0.31$; $I^2 = 4.6$ percent).

Figure 34. Meta-analysis of the effect of TM® versus WL on blood pressure



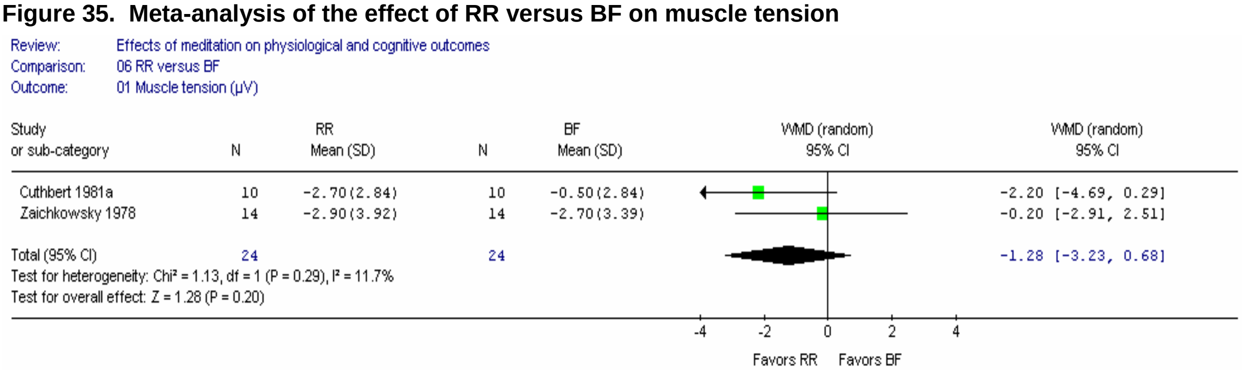
Relaxation Response

Six studies[191,283,284,288,304,306b] assessing the effect of RR on physiological and neuropsychological outcomes were identified for meta-analysis: five RCTs[191,283,284,288,304] and one NRCT.[306b] Two studies compared RR versus BF[191,306b] and four compared RR versus rest.[283,284,288,304]

RR versus BF

Muscle tension. Two studies[306b,191] totaling 48 participants (RR = 24, BF = 24) provided data on the effect of RR on muscle tension (Figure 35). The combined results of changes in muscle tension (microvolts) indicated a small, nonsignificant change favoring RR (WMD = -1.28; 95% CI, -3.23 to 0.68). There was little heterogeneity in the study results ($p = 0.29$; $I^2 = 11.7$ percent).

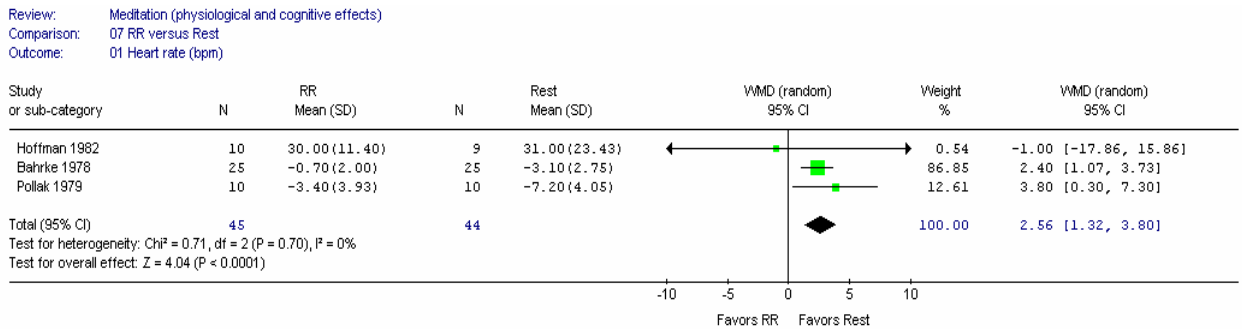
Figure 35. Meta-analysis of the effect of RR versus BF on muscle tension



RR versus rest

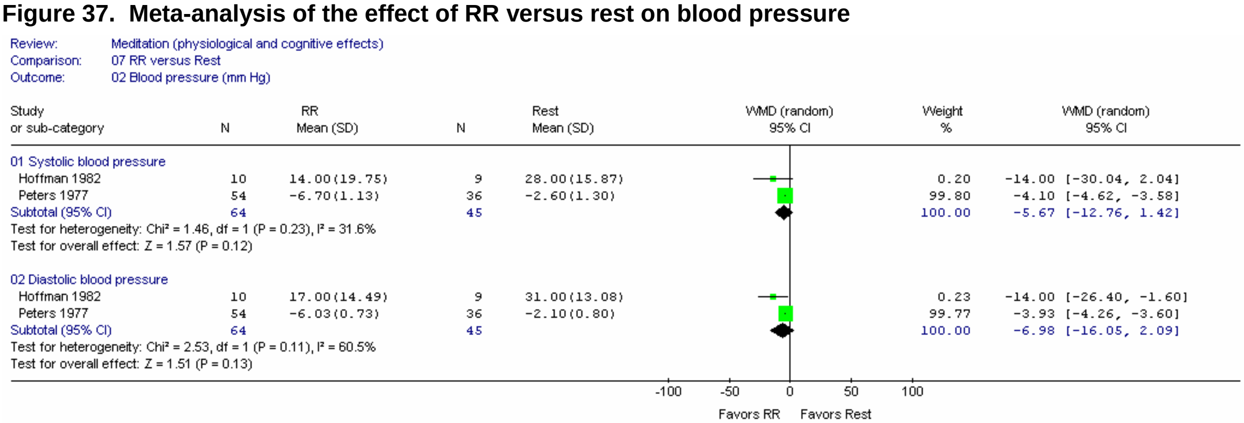
Heart rate. Three trials[283,288,304] totaling 99 participants (RR = 45, rest = 44) provided data on the effect of RR on heart rate in healthy populations (Figure 36). The combined estimate of changes in heart rate (bpm) showed a significant improvement (reduction) favoring rest (WMD = 2.56; 95% CI, 1.32 to 3.80). The study results were homogeneous (p = 0.70, I^2 = 0 percent).

Figure 36. Meta-analysis of the effect of RR versus rest on heart rate



Blood pressure. Two studies[283,284] totaling 109 participants (RR = 45, rest = 44) provided data on the effect of RR on blood pressure in healthy populations (Figure 37). The combined estimate of changes in SBP (mm Hg) indicated a small, nonsignificant improvement (reduction) favoring RR (WMD = -5.67; 95% CI, -12.76 to 1.42). There was evidence of moderate heterogeneity between the study results (p = 0.23; I^2 = 31.6 percent). The combined estimates for DBP showed a small, nonsignificant improvement favoring RR (WMD = -6.98; 95% CI, -16.05 to 2.09). There was evidence of considerable heterogeneity between the study results (p = 0.11; I^2 = 60.5 percent). Both studies were short-term and similar in participant characteristics (proportion of males to females, healthy) and intervention. The most likely source of heterogeneity is study design (RCT[284] versus NRCT[283]).

Figure 37. Meta-analysis of the effect of RR versus rest on blood pressure



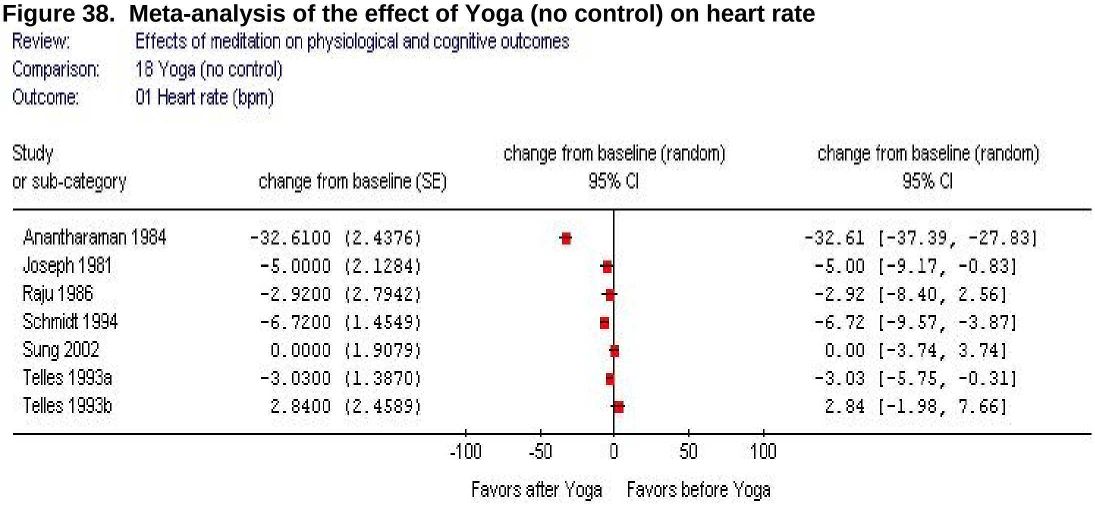
Yoga

Twenty-eight studies assessing the physiological and neuropsychological effect of Yoga were identified for meta-analysis: 8 RCTs,[140,177,204,278,280,281,305,308] 2 NRCTs,[180,181] and 18 before-and-after studies.[83,294,297,298,300-303,310,312-315,318,320-323] Four trials[168,204,305,325] compared Yoga versus NT, two trials[280,281] compared Yoga versus exercise, two[177,181] compared Yoga versus free breathing (FB), two[278,308] compared Yoga versus medication, and two[140,180] compared Yoga (unilateral left nostril breathing [ULNB]) versus another Yoga intervention (unilateral right nostril breathing [URNB]).

Yoga (no control)

Heart rate. Seven before-and-after studies[83,302,310,313,320,322,323] (17, 10, 12, 50, 25, 40, and 18 participants, respectively) provided data on the effect of Yoga (no control) on heart rate (bpm) in healthy populations (Figure 38). The substantial heterogeneity among the study results ($p < 0.00001$; $I^2 = 95.9$ percent) precluded reporting a combined estimate. Four of the seven studies indicated significant improvements (reduction) after practicing Yoga,[302,310,313,323] whereas three did not favor the intervention.[83,320,322]

Figure 38. Meta-analysis of the effect of Yoga (no control) on heart rate

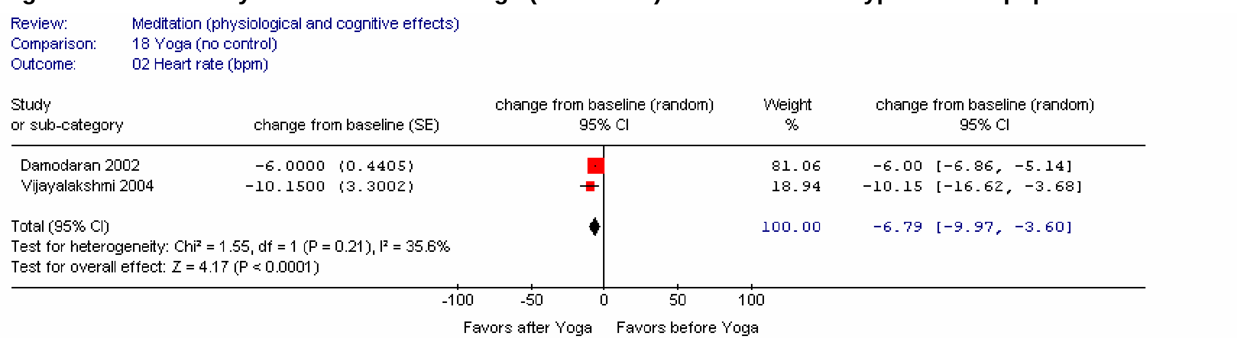


Possible sources for the observed heterogeneity were explored. Two studies were very short-term and reported study duration in number of sessions (one to six).[83,322] The remaining five studies had a 3-month study period.[302,310,313,320,323] The studies also differed in the frequency and length of intervention sessions: two studies reported sessions of less than 1 hour,[83,322] two studies reported 1-hour sessions,[313,320] two studies reported sessions of 4 hours,[302,323] and one study[310] did not report session length. Five studies were considered to have used composite interventions[302,310,313,320,323] composed of some combination of postures, breathing techniques, cleansing practices, meditation, and lectures. Two studies were considered to have used single interventions; however, the two studies employed different techniques (breathing exercises[322] and Raja meditation[83]).

The age range of participants also varied, with the mean ages ranging from 25[313] to 35 years.[322] Three studies included only men,[83,313,323] one study included only women,[310] two studies included both men and women in almost equal proportion,[302,320] and one study failed to report the gender of participants.[322]

Two studies[294,303] totaling 33 participants provided data on the effect of Yoga on heart rate in hypertensive populations (Figure 39). The combined estimate of changes in heart rate (bpm) showed a small, significant improvement (reduction) favoring Yoga (change from baseline = -6.79; 95% CI, -9.97 to -3.60). There was evidence of moderate heterogeneity among the study results ($p = 0.21$, $I^2 = 35.6$ percent). The possible sources of heterogeneity were explored. While the subjects in both studies were similar in mean age, the Vijayalakshmi study[303] did not include women, whereas Damodaran[294] had a male to female ratio of 1:4. The two studies also differed in quality with Damodaran[294] having a study population considered representative of the population of interest, while Vijayalakshmi[303] had a nonrepresentative study population.

Figure 39. Meta-analysis of the effect of Yoga (no control) on heart rate in hypertensive populations

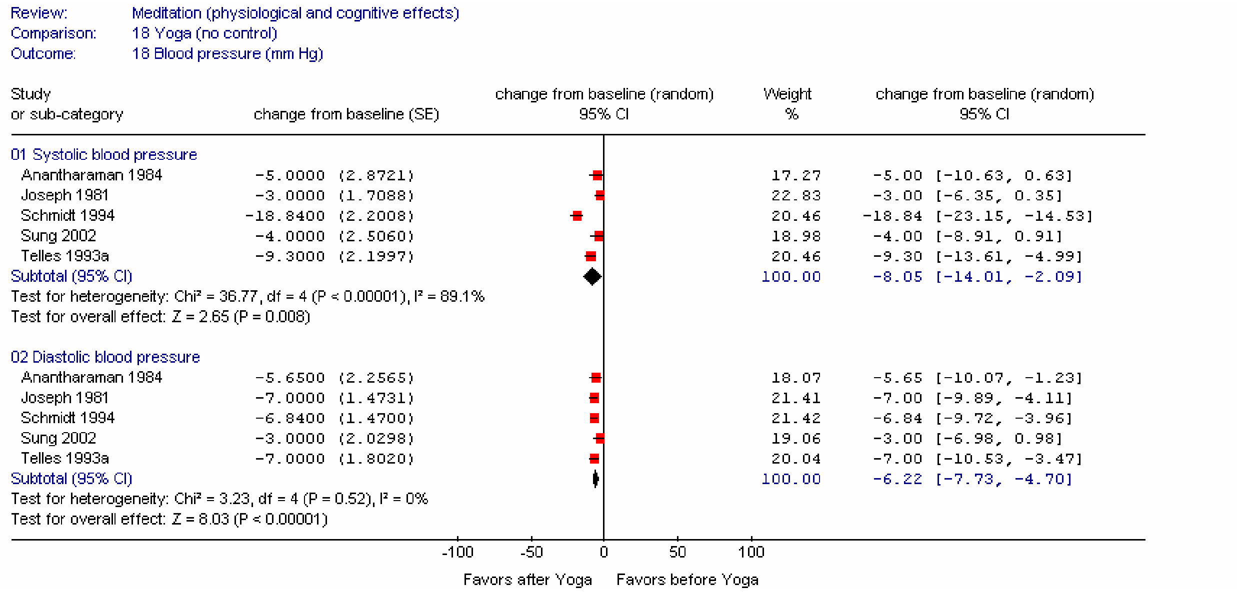


Blood pressure. Five studies[302,310,313,322,323] totaling 201 participants provided data on the effect of Yoga on blood pressure in healthy populations (Figure 40). The combined estimate of changes in SBP (mm Hg) indicated a small, significant improvement (reduction) favoring Yoga (change from baseline = -8.05; 95% CI, -14.01 to -2.09). There was evidence of substantial heterogeneity among the study results ($p = 0.00001$; $I^2 = 89.1$ percent).

The combined estimate of changes in DBP (mm Hg) also indicated a small, significant improvement (reduction) favoring Yoga (change from baseline = -6.22; 95% CI, -7.73 to -4.70). The study results were homogeneous ($p = 0.52$; $I^2 = 0$ percent).

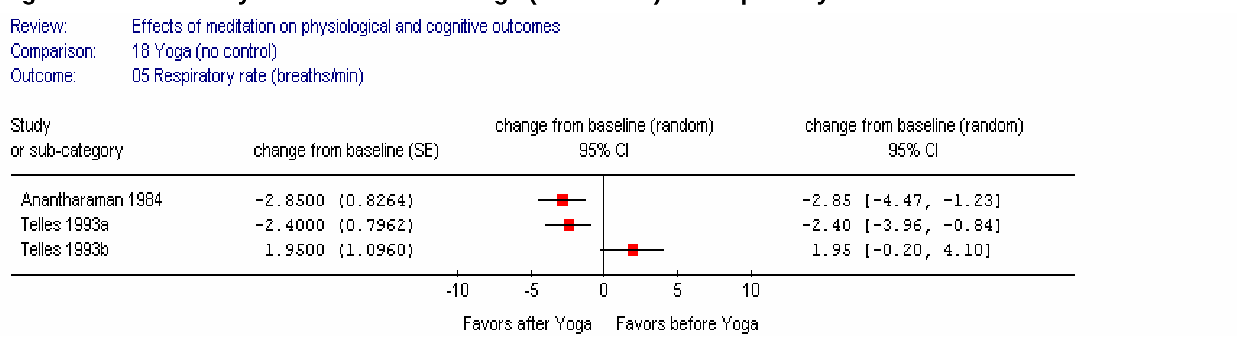
The discrepancy between the measures of heterogeneity found for SBP and DBP is possibly accounted for by the difference in baseline measures. The participants in the Schmidt[302] study had a combined SBP baseline noticeably higher (9 mm Hg from the next highest) than the those of the other studies, and it is unclear what clinical differences may be responsible for this difference in baseline measures. Other than baseline measures, the studies were comparable in study design, duration, and other participant characteristics. The baseline measures of DBP were similar across all groups.

Figure 40. Meta-analysis of the effect of Yoga (no control) on blood pressure



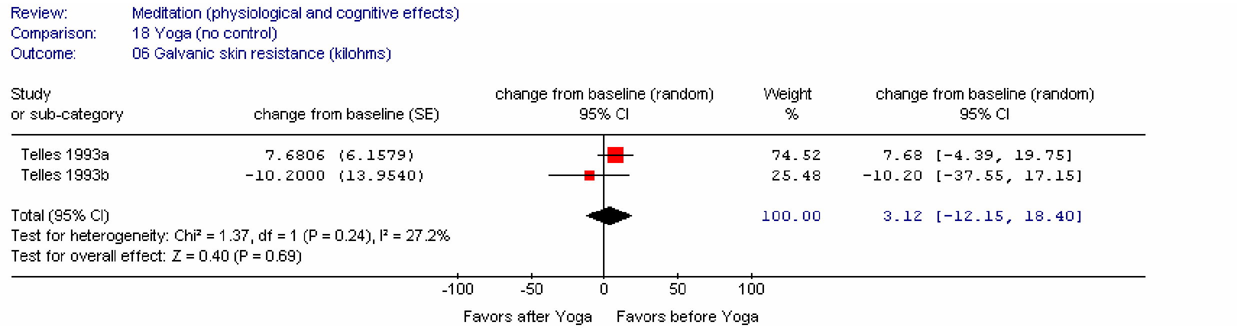
Respiratory rate. Three studies[83,310,323] with 17, 40, and 18 participants respectively provided data on the effect of Yoga on respiratory rate in healthy populations (Figure 41). The heterogeneity among study results was substantial (p = 0.0001; I^2 = 85.5 percent) and precluded combining the studies. The Telles study[83] differed from the other two studies in duration and the type of yogic practice used. Anantharaman[323] and Telles[323] were short-term (3-month) studies using postures and breathing exercises. In contrast, Telles[83] employed Raja yoga meditation (seated meditation with a fixed gaze) that lasted three sessions (approximately 1 week).

Figure 41. Meta-analysis of the effect of Yoga (no control) on respiratory rate



Galvanic skin resistance. Two studies[83,323] totaling 58 participants provided data on the effect of Yoga on galvanic skin resistance in healthy populations (Figure 42). The combined estimate of changes in skin resistance (kilohms) indicated a nonsignificant difference favoring the "before Yoga" period (change from baseline = 3.12, 95% CI, -12.15 to 18.40). There was evidence of moderate heterogeneity between the study results (p = 0.24, I^2 = 27.2 percent).

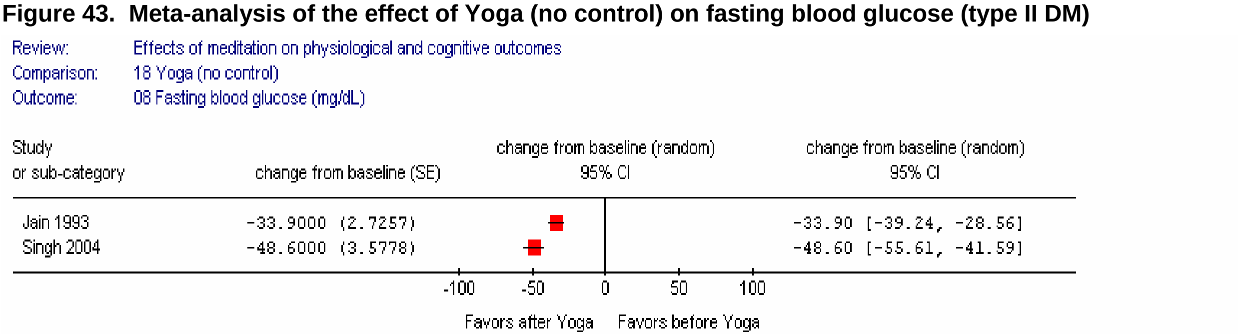
Figure 42. Meta-analysis of the effect of Yoga (no control) on galvanic skin resistance



The possible sources of heterogeneity in the outcome of galvanic skin resistance were differences in the intervention, comparison period, and duration of study. One study[323] used a multicomponent intervention that consisted of yogic postures, breathing exercises, meditation, cleansing exercises, and lectures. The comparison period preceded the learning of any yogic techniques, but was not fully described. The outcome measurements were taken at the end of a 3-month period. The second study[83] used a seated meditation technique in which participants fixed their gaze on a light and thought positive thoughts about a universal force. The nonmeditation period involved sitting quietly without targeted thinking; the outcome measures were assessed the day after the baseline measures.

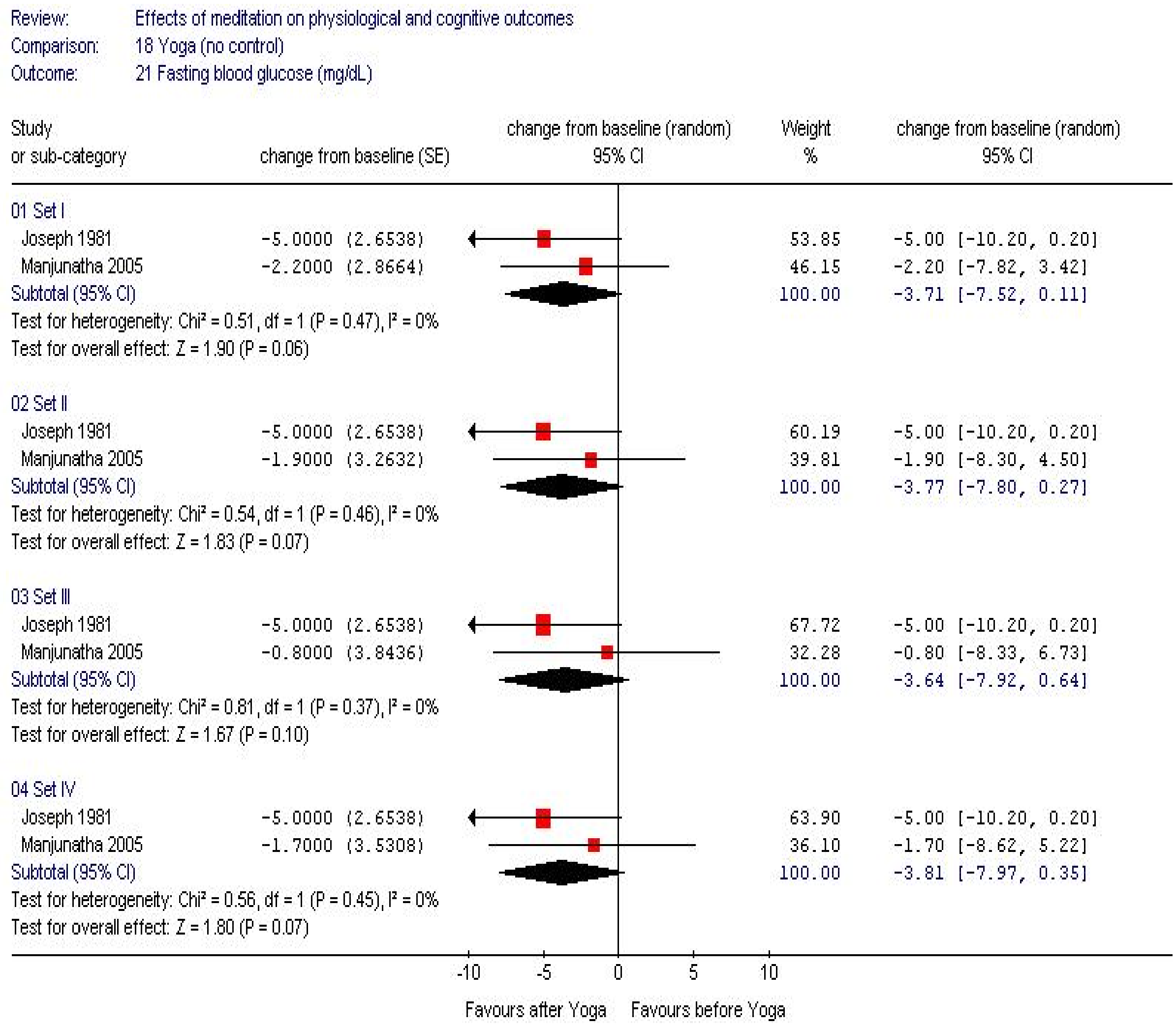
Fasting blood glucose (type II DM). Two studies,[298,321] with 149 and 24 participants respectively, provided data on the effect of Yoga on levels of fasting blood glucose in populations with type II DM (Figure 43). The heterogeneity of the combined study results was too high ($p = 0.001$; $I^2 = 90.6$ percent) to report an overall estimate. While both studies employed Yoga postures and breathing techniques, Jain[298] employed two breathing techniques called “kapalbhati” (also described as a cleansing practice and a milder form of bhastrika[119]) and “ujjayi,” and a variety of postures and cleansing practices. Singh[321] employed “bhastrika pranayama”(a breathing exercise) and postures, and did not use cleansing practices. In addition, while the Singh study used sessions of about 30 minutes duration, the daily sessions in the Jain study lasted 2.5 hours (1.5 hours in the morning and 1 hour in the evening).

Figure 43. Meta-analysis of the effect of Yoga (no control) on fasting blood glucose (type II DM)



Fasting blood glucose (healthy). Two studies[301,313] totaling 30 participants provided data on the effect of Yoga on levels of fasting blood glucose in healthy populations (Figure 44). The study of Manjunatha[301] provided data on the effect of four different sets of two asana techniques. For each of the sets, we pooled the results with the results from the Joseph[313] study. Each of the combined estimates of change in blood glucose level (mg/dL) showed a small, nonsignificant improvement (reduction) favoring Yoga (change from baseline ranged from -3.64 [95% CI, -7.92 to 0.64] to -3.81 [95% CI, -7.97 to 0.35]). There was no evidence of heterogeneity for any of the pooled results (p-values range from 0.37 to 0.47; I^2 = 0 percent).

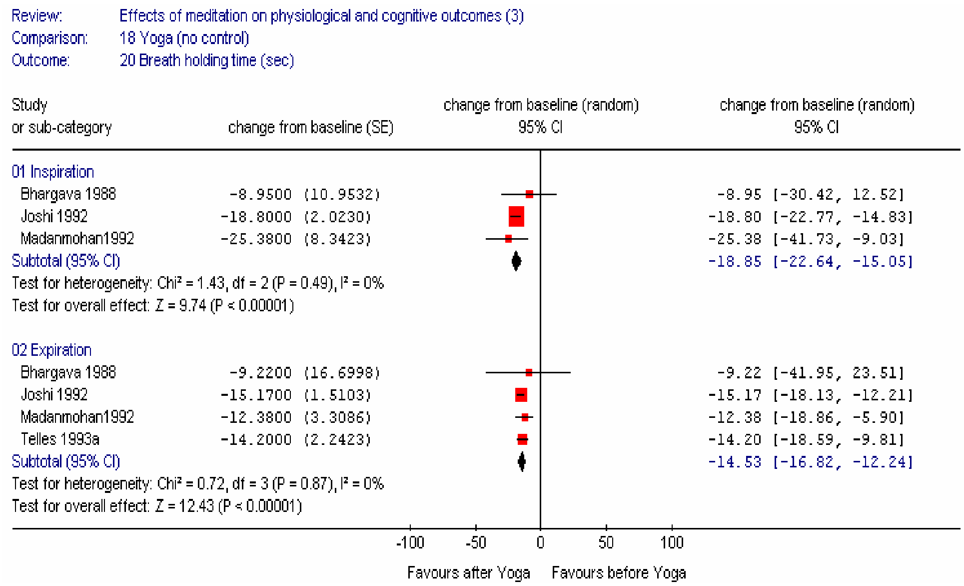
Figure 44. Meta-analysis of the effect of Yoga (no control) on fasting blood glucose



Breath holding time. Four studies[300,312,314,323] provided data on the effect of Yoga on breath holding time (seconds) in healthy populations. Three studies[300,312,314] totaling 112 participants examined breath holding time after inspiration The combined results of changes indicated a large improvement (increase) after practicing Yoga (change from baseline = -18.85; 95% CI, -22.64 to -15.05). The study results were homogeneous (p = 0.49; I^2 = 0 percent).

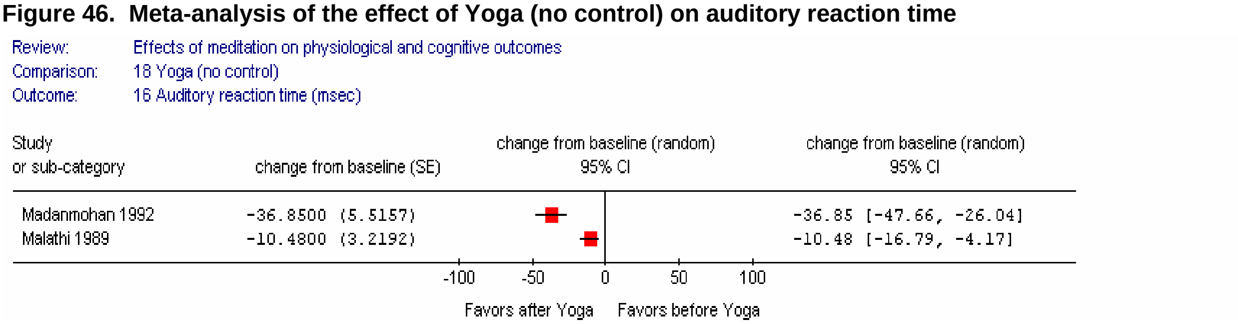
Four studies[300,312,314,323] totaling 152 participants examined breath holding after exhalation. The combined results of changes indicated a large improvement (increase) after practicing Yoga (change from baseline = -14.53; 95% CI, -16.82 to -12.24). The study results were homogeneous (p = 0.87, I^2 = 0 percent) (Figure 45).

Figure 45. Meta-analysis of the effect of Yoga (no control) on breath holding time after inspiration and expiration



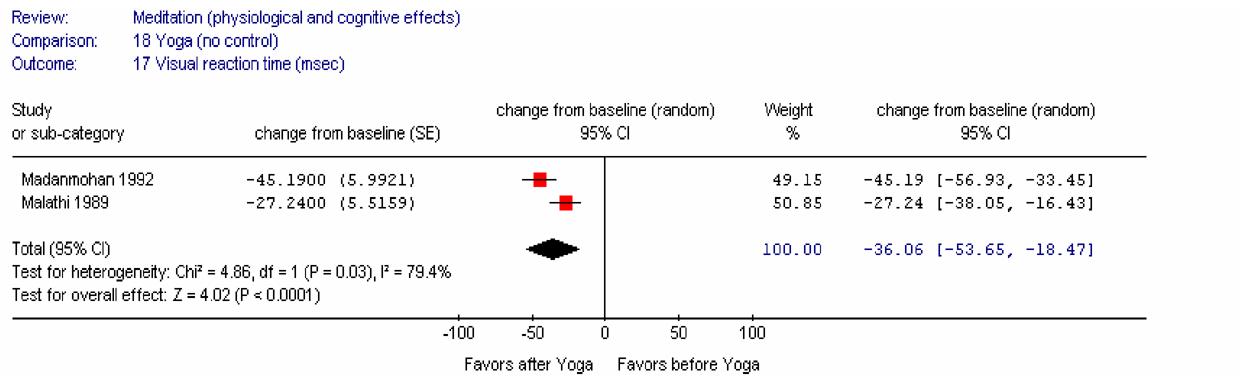
Auditory reaction time. Two trials,[300,318] with 27 and 41 participants respectively, provided data on the effect of Yoga on auditory reaction time (milliseconds) (Figure 46). Though both studies found statistically significant results favoring Yoga, the results of the studies were too heterogeneous to report as a combined estimate (p = 0.0001; I^2 = 94.1 percent). Possible sources of heterogeneity include characteristics of study participants and duration of the intervention. Madanmohan[300] included men only with an age range from 18 to 21 years. Malathi[318] included men only with an age range from 30 to 45 years. Both studies were short-term; however, the Madanmohan[300] study had a duration of 12 weeks compared to six weeks for the Malathi study.[318] Finally, participants in the Madanmohan[300] study practiced Yoga for 30 minutes per day; those in the Malathi[318] study practiced 1 hour per day.

Figure 46. Meta-analysis of the effect of Yoga (no control) on auditory reaction time



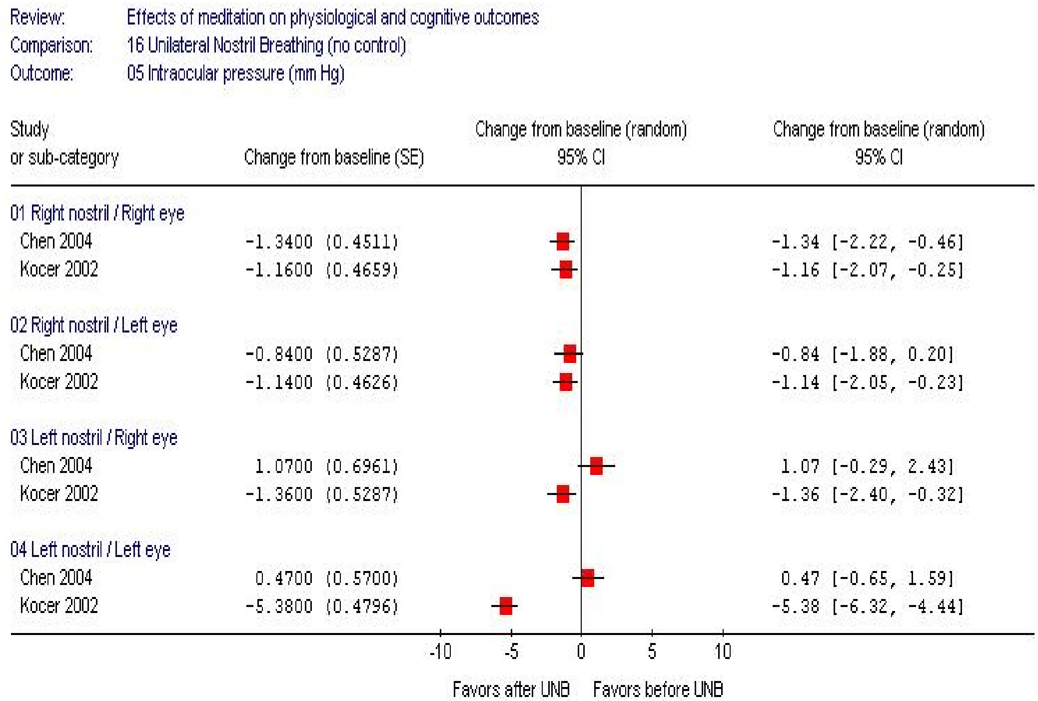
Visual reaction time. Two studies[300,318] totaling 110 participants provided data on the effect of Yoga on visual reaction time (Figure 47). The combined estimate of change in visual reaction time (milliseconds) indicated a small, significant improvement (reduction) favoring Yoga (change from baseline = -36.06; 95% CI, -53.65 to -18.57). There was evidence of substantial heterogeneity between the study results (p = 0.03, I^2 = 79.4 percent). As noted in the previous section, the observed heterogeneity is possibly accounted for by differences in participant characteristics, study duration, and duration of practice.

Figure 47. Meta-analysis of the effect of Yoga (no control) on visual reaction time



Intraocular pressure. Two studies[297,315] totaling 67 participants provided data on the effect of Yoga (unilateral nostril breathing [UNB]) on intraocular pressure in healthy populations (Figure 48). The two studies assessed ipsi- and contralateral eye and nostril combinations. We did not pool the results of the studies because the outcomes were measured under different conditions, which may have resulted in the observed heterogeneity. Chen[297] took before and after measures while the study participants were at rest. Kocer[315] took baseline measures while participants were resting; the "after" measures were taken during exercise. Kocer[315] reported a statistically significant change favoring UNB for all eye/nostril combinations. In contrast, Chen[297] reported a nonsignificant change favoring no UNB for left nostril breathing. For right nostril breathing, the results favored UNB; however, only the right nostril/right eye combination was statistically significant.

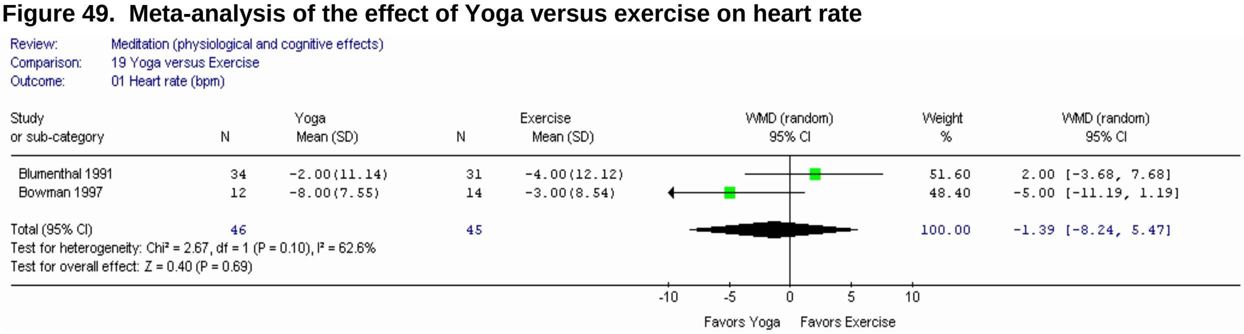
Figure 48. Meta-analysis of the effect of Yoga (no control) on intraocular pressure



Yoga versus exercise.

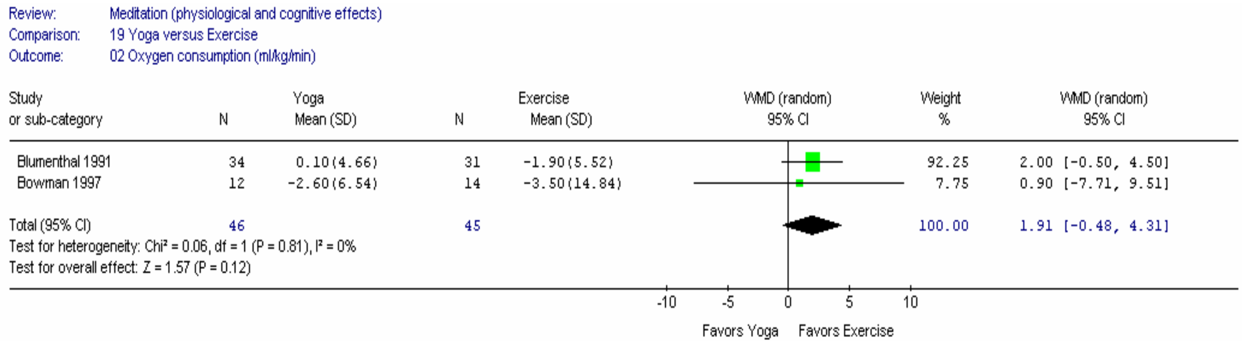
Heart rate. Two trials[280,281] totaling 91 participants provided data on the effect of Yoga on heart rate in healthy populations (Figure 49). The combined estimate of changes in heart rate (bpm) indicated a small, nonsignificant improvement (reduction) favoring Yoga (WMD = -1.39; 95% CI, -8.24, 5.47). There was evidence of high heterogeneity between the study results (p = 0.10, I^2 = 62.6%). The heterogeneity is possibly accounted for by the difference in study duration. Blumenthal[280] was a short-term study (6 weeks) that found statistically nonsignificant results favoring exercise and Bowman[281] was a long-term study (14 months) that found statistically nonsignificant results favoring Yoga.

Figure 49. Meta-analysis of the effect of Yoga versus exercise on heart rate



Oxygen consumption. Two studies[280,281] totaling 91 patients provided data on the effect of Yoga on oxygen consumption in healthy populations (Figure 50). The combined estimate of changes in VO_2 max (ml/kg/min) indicated a small, nonsignificant improvement (increase) favoring exercise (WMD = 1.91; 95% CI, -0.48 to 4.31). The study results were homogeneous (p = 0.81, I^2 = 0%).

Figure 50. Meta-analysis of the effect of Yoga versus exercise on oxygen consumption (VO_2 max)

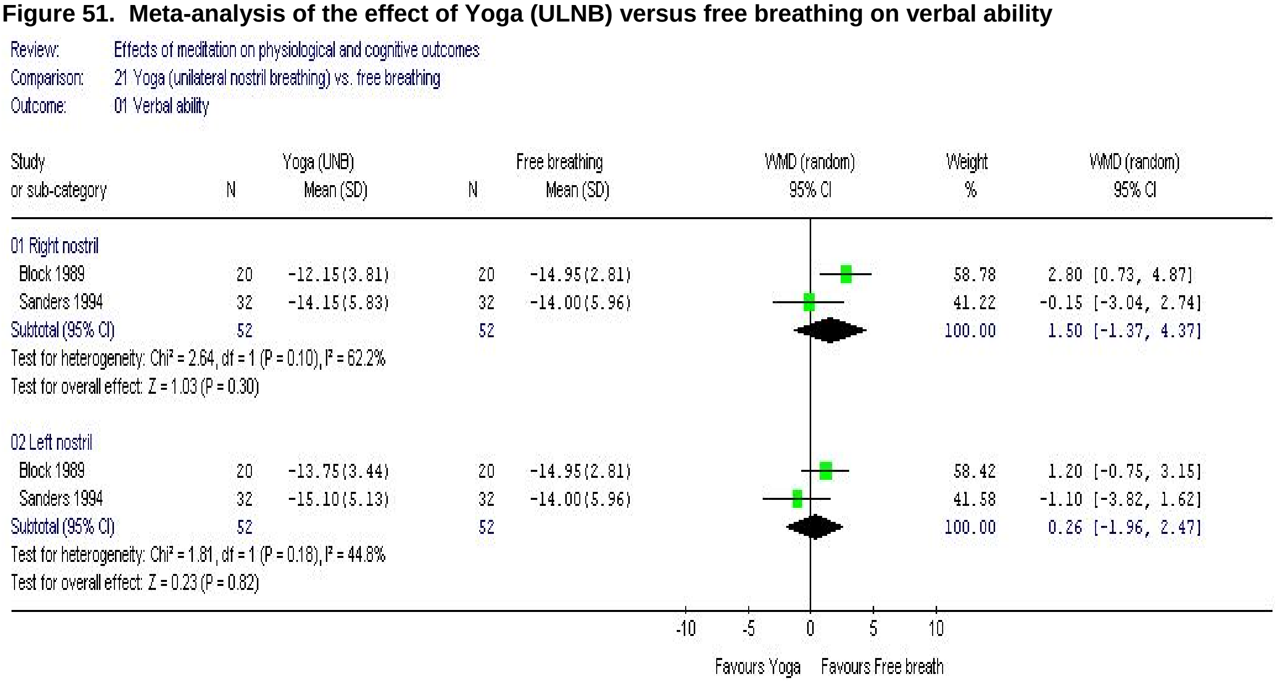


Yoga versus free breathing.

Verbal ability. Two studies[177,181] totaling 104 participants (Yoga = 52, free breathing = 52) provided data on the effect of Yoga, specifically, unilateral left and right nostril breathing (ULNB, URNB), on verbal ability based on a consonant-vowel matching task (Figure 51). For ULNB, the combined estimate of changes in verbal ability (score) indicated a small, nonsignificant improvement (increase) favoring free breathing (WMD = 0.26; 95% CI, -1.96 to 2.47). There was evidence of moderate heterogeneity between the study results ($p = 0.18$; I^2 = 44.8 percent).

For URNB, the combined estimate of changes in verbal ability (score) indicated a small, nonsignificant improvement (increase) favoring free breathing (WMD = 1.50; 95% CI, -1.37 to 4.37). There was evidence of substantial heterogeneity between the study results ($p = 0.10$; I^2 = 62.2 percent). A possible source of heterogeneity may be study design. Block[177] used an RCT design while Sanders[181] employed an NRCT design and found statistically nonsignificant results favoring Yoga. Both studies were of low methodological quality. Lack of reporting prevented further exploration of sources of heterogeneity related to participant characteristics, and study duration.

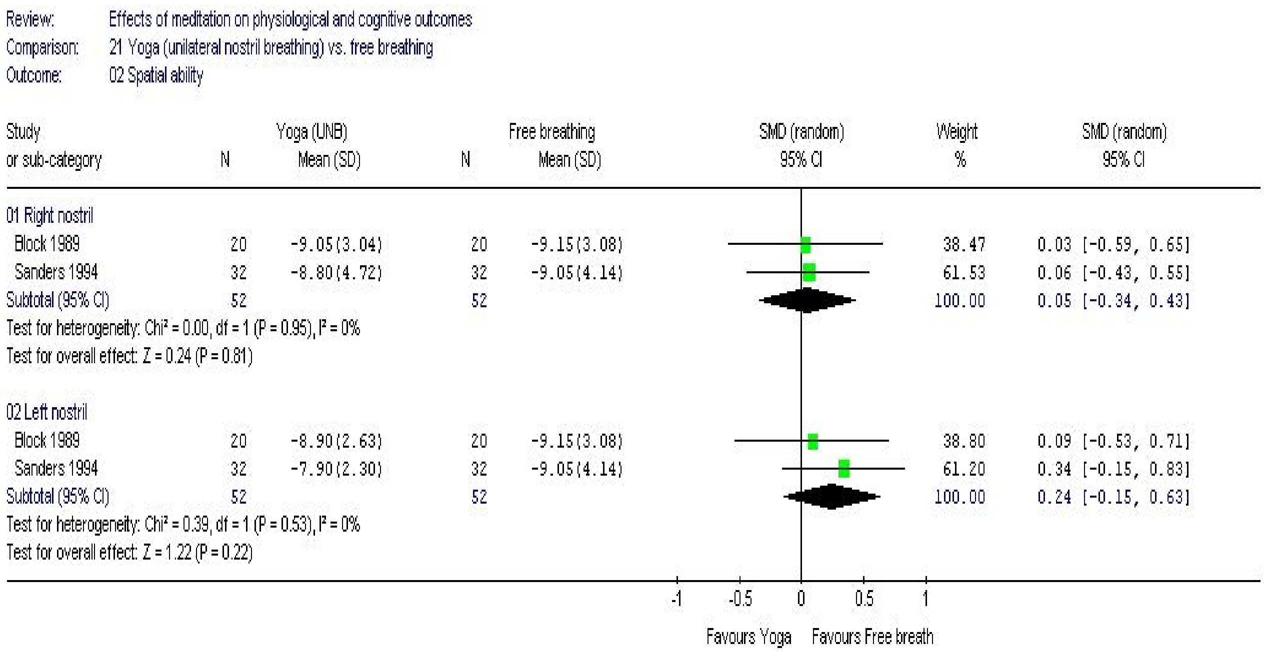
Figure 51. Meta-analysis of the effect of Yoga (ULNB) versus free breathing on verbal ability



Spatial ability. Two studies[177,181] totaling 104 participants (Yoga = 52, free breathing = 52) provided data on the effect of Yoga, specifically (ULNB and URNB) on measures of spatial ability (Figure 52). For ULNB, the combined measures of spatial ability (score) indicated a nonsignificant improvement (increase) favoring free breathing (SMD = 0.05; 95% CI, -0.34 to 0.43). The study results were homogeneous (p = 0.95; I^2 = 0 percent).

For URNB, the combined estimate of change in measures of spatial ability indicated a nonsignificant improvement (increase) favoring free breathing (SMD = 0.24; 95% CI, -0.15 to 0.63). The study results were homogeneous (p = 0.53; I^2 = 0 percent).

Figure 52. Meta-analysis of the effect of Yoga (ULNB and URNB) versus free breathing on spatial ability

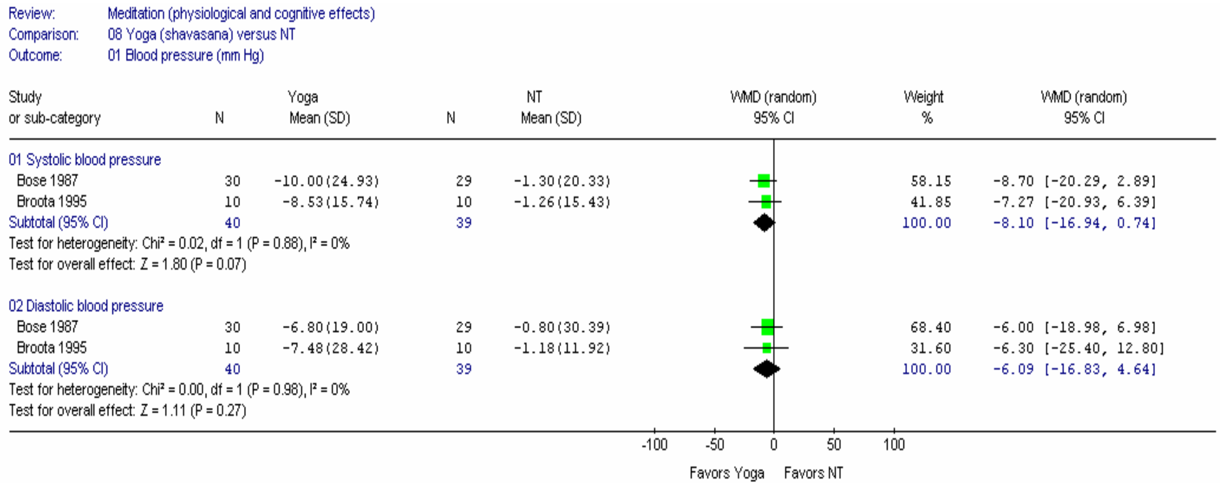


Yoga versus NT

Blood pressure. Two studies[204,305] totaling 79 participants (Yoga = 40, NT = 39) provided data on the effect of Yoga (Shavasana) on blood pressure in healthy populations (Figure 53). The combined estimate of change in SBP (mm Hg) indicated a small, nonsignificant improvement (reduction) favoring Yoga (WMD = -8.10; 95% CI, -16.94 to 0.74). The study results were homogeneous (p = 0.88; I^2 = 0 percent).

The combined estimate of changes in DBP (mm Hg) also indicated a small, nonsignificant improvement (reduction) favoring Yoga (WMD = -6.09; 95% CI, -16.83 to 4.64). The study results were homogeneous (p = 0.98; I^2 = 0 percent).

Figure 53. Meta-analysis of the effect of Yoga (shavasana) versus NT on blood pressure

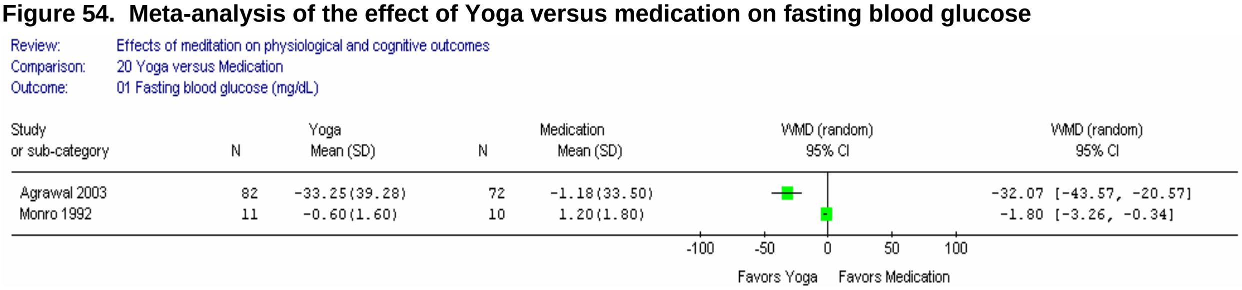


Yoga versus medication

Fasting blood glucose. Two studies,[278,308] with 154 (Yoga = 82, medication = 72) and 21 (Yoga = 11, medication = 10) participants respectively, provided data on the effect of Yoga on fasting blood glucose in populations with type II DM (Figure 54). The heterogeneity between the results was too high to report a combined result ($p < 0.00001$; $I^2 = 96.2$ percent). The results of Agrawal[278] indicated a large, significant improvement (reduction) favoring Yoga (mean difference = -32.07; 95% CI, -43.57 to -20.57). The results of Monro[308] showed a smaller, but still significant improvement (reduction) favoring Yoga (mean difference = -1.80; 95% CI, -3.26 to -0.34).

Possible sources of heterogeneity are differences in the proportion of males and females included in the studies and the complexity of the interventions. Agrawal[278] had a proportion of males to females of approximately 1:1 and Monro[308] had a proportion of approximately 2:1. In addition, the Agrawal study[278] used a complex intervention consisting of Yoga asanas, diet modification, aerobic exercise, and HE, whereas the Monro study[308] used a standard set of postural, breathing, and relaxation exercises.

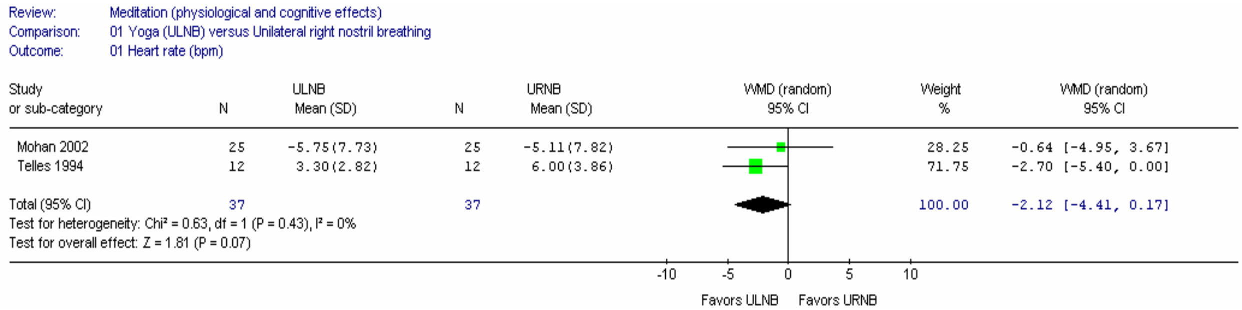
Figure 54. Meta-analysis of the effect of Yoga versus medication on fasting blood glucose



Yoga (ULNB) versus Yoga (URNB).

Heart rate. Two studies[140,180] totaling 74 participants (ULNB = 37, URNB = 37) provided data on the effect of Yoga (ULNB) on heart rate in healthy populations (Figure 55). The combined estimate of changes in heart rate (bpm) showed a small, nonsignificant improvement (reduction) favoring ULNB (WMD = -2.12; 95% CI, -4.41, 0.17). The study results were homogeneous ($p = 0.43$; $I^2 = 0$ percent)

Figure 55. Meta-analysis of the effect of Yoga (ULNB) versus URNB on heart rate



Tai Chi

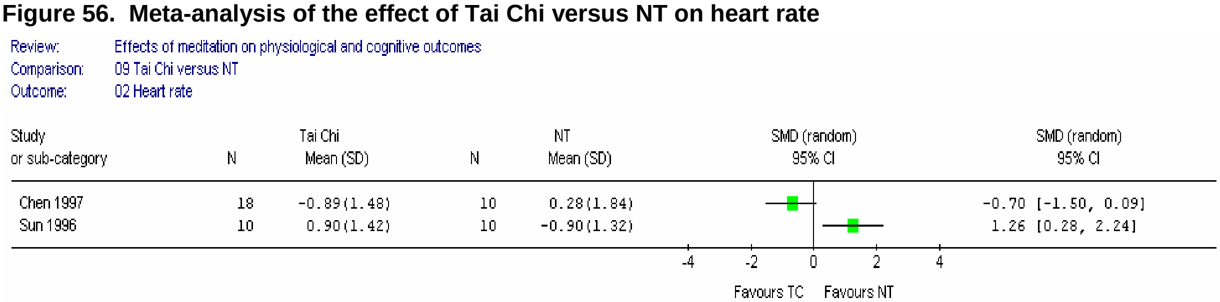
Seven studies assessing the physiological and neuropsychological effect of Tai Chi were identified for meta-analysis: four RCTs,[285-287,307] one NRCT,[290] and two before-and-after studies.[296,317] Four studies compared Tai Chi to NT,[285,286,290,326] and two compared Tai Chi versus exercise.[287,307]

Tai Chi versus NT

Heart rate. Two studies,[285,290] with 28 (Tai Chi = 18, NT = 10) and 20 (Tai Chi = 10, NT = 10) participants respectively, provided data on the effect of Tai Chi on resting heart rate in healthy, elderly populations (Figure 56). The heterogeneity in the study results was too high to report a combined result (p = 0.002; I^2 = 89.2 percent). The results of Chen[290] indicated a small, nonsignificant change favoring Tai Chi (mean difference = -0.70; 95% CI, -1.50 to 0.09). In contrast, Sun[285] showed a larger, significant improvement (reduction) favoring NT (mean difference = 1.26; 95% CI, 0.28 to 2.24).

The opposite direction of effect between the two studies is possibly a result of the study design, frequency of practice, or complexity of the intervention. Chen[290] used an NRCT design, while Sun[285] conducted an RCT. In addition, the participants in the Chen study practiced a Tai Chi program of 24 forms for 1 hour twice weekly. The participants in the Sun study[285] practiced 2 hours once a week and incorporated HE and stress management techniques in addition to a Tai Chi program.

Figure 56. Meta-analysis of the effect of Tai Chi versus NT on heart rate

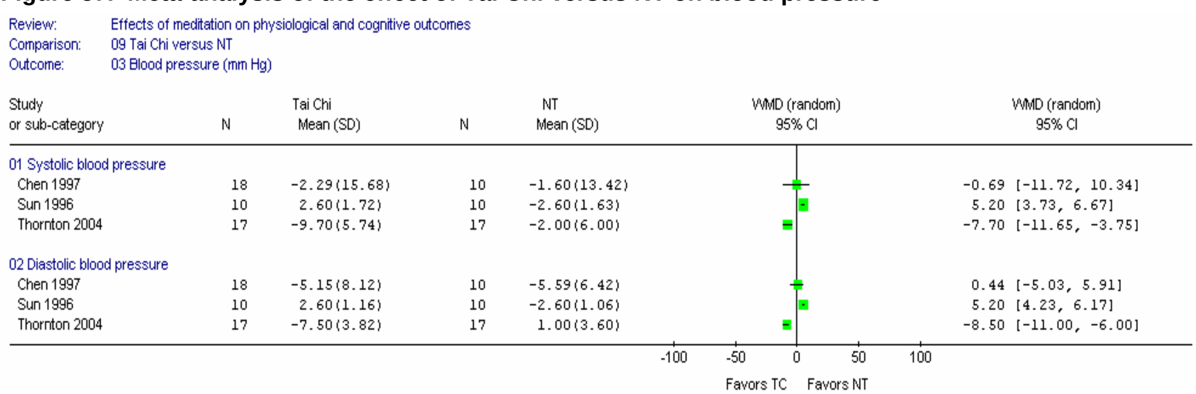


Blood pressure. Three studies[285,286,290] with 28 (Tai Chi = 18, NT = 10), 20 (Tai Chi = 10, NT = 10), and 34 (Tai Chi = 17, NT = 17) participants respectively provided data on the effect of Tai Chi on blood pressure in healthy populations (Figure 57). The results were too heterogeneous to report as a combined estimate (p = 0.001, I^2 = 94.5%). The results of the Chen[290] study showed a small, nonsignificant improvement (reduction) favoring Tai Chi (mean difference = -0.69; 95% CI, -11.72 to 10.34). Sun[285] indicated a moderate, significant improvement (reduction) favoring NT (mean difference = 5.20; 95% CI, 3.73 to 6.67), and the results of Thornton[286] showed a moderate, significant improvement (reduction) favoring Tai Chi (mean difference = -7.70; 95% CI, -11.65 to -3.75).

The heterogeneity in results for changes in DBP (mm Hg) also precluded reporting a combined estimate ($p = 0.00001$; $I^2 = 98\%$). Chen[290] reported a small, nonsignificant improvement (reduction) favoring Tai Chi (mean difference = 0.44; 95% CI, -5.03 to 5.91). Sun[285] reported a moderate, significant improvement (reduction) favoring NT (mean difference = 5.20; 95% CI, 4.23 to 6.17), and the results of Thornton[286] showed a moderate, significant improvement (reduction) favoring Tai Chi (mean difference = -8.50; 95% CI, -11.00 to -6.00).

The possible sources of heterogeneity are the age of the study participants and the frequency of practice. While Thornton[286] used healthy volunteers between the ages of 33 to 55 years (mean age 48 years), Sun[285] employed healthy elderly participants over 60 years of age. The Chen[290] study used participants between the ages of 50 and 74 years. The Sun[285] and Thornton[286] studies used a similar frequency and form of Tai Chi intervention (two to three times per week, 108 forms), while the Chen[290] study employed only one Tai Chi session per week and did not describe the number of forms or Tai Chi style used.

Figure 57. Meta-analysis of the effect of Tai Chi versus NT on blood pressure



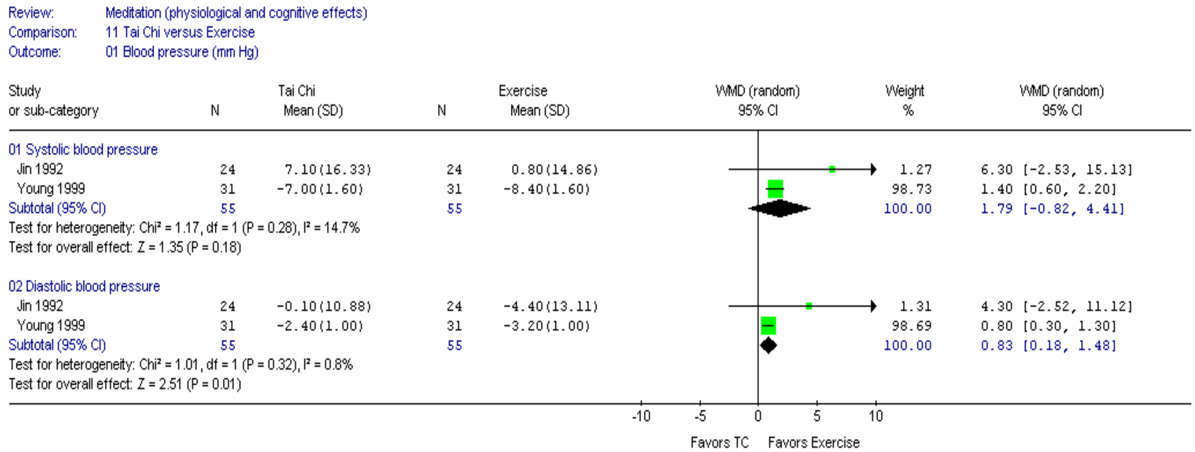
Tai Chi versus exercise

Blood pressure. Two RCTs[287,307] totaling 110 participants (Tai Chi = 55, exercise = 55) provided data on the effect of Tai Chi on blood pressure in healthy populations (Figure 58). The combined estimate of changes in SBP (mm Hg) showed a moderate, nonsignificant improvement (reduction) favoring exercise (WMD = 1.79; 95% CI, -0.82 to 4.41). There was evidence of low heterogeneity between the studies regarding the mean change in SBP ($p = 0.28$; $I^2 = 14.7$ percent).

The combined estimate of changes in DBP (mm Hg) showed a small, significant improvement (reduction) favoring exercise (WMD = 0.83; 95% CI, 0.18 to 1.48). There was evidence of low heterogeneity between the studies regarding the mean change in DBP ($p = 0.32$; $I^2 = 0.8$ percent). The heterogeneity is possibly accounted for by the difference in the ages of the participants, and the frequency and duration of the intervention. Jin[307] used healthy volunteers with a mean age of 36 years; Young[287] used healthy elderly participants with a mean age of 67 years. The Jin study employed two

1-hour Tai Chi sessions, whereas the Young study lasted 12 weeks and had four 30-minute sessions of Tai Chi per week.

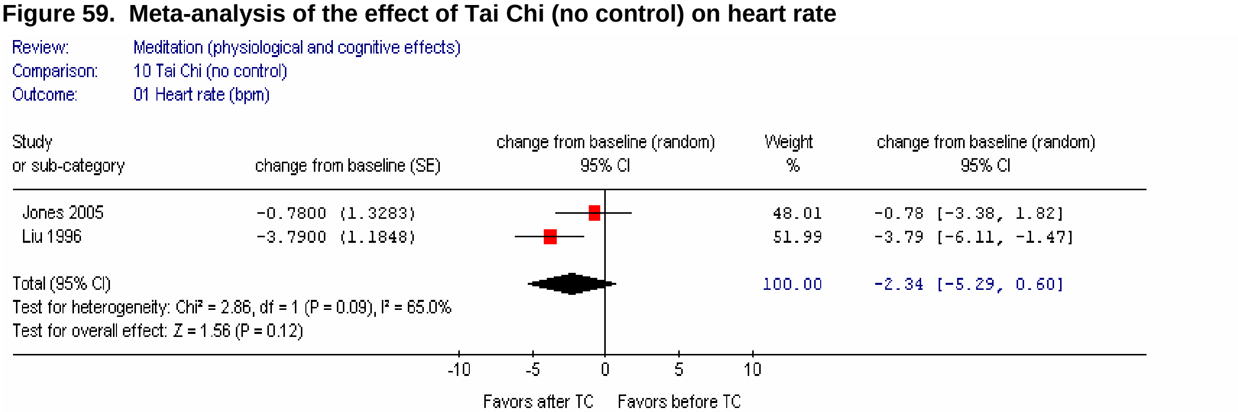
Figure 58. Meta-analysis of the effect of Tai Chi versus exercise on blood pressure



Tai Chi (no control)

Heart rate. Two studies[296,317] totaling 74 participants provided data on the effect of Tai Chi on heart rate in healthy populations (Figure 59). The combined estimate of changes in heart rate (bpm) indicated a small, nonsignificant improvement (reduction) favoring Tai Chi (change from baseline = -2.34; 95% CI, -5.29 to 0.60). There was evidence of heterogeneity between the studies ($p = 0.09$, $I^2 = 65$ percent). A possible source of heterogeneity is the difference in the age of study participants. The mean age of participants in Jones[296] was 53 ± 10 years; the mean age of participants in Liu[317] was 22 ± 3 years. Liu[317] did not report the frequency or complexity of the intervention used, so the studies could not be compared for these variables.

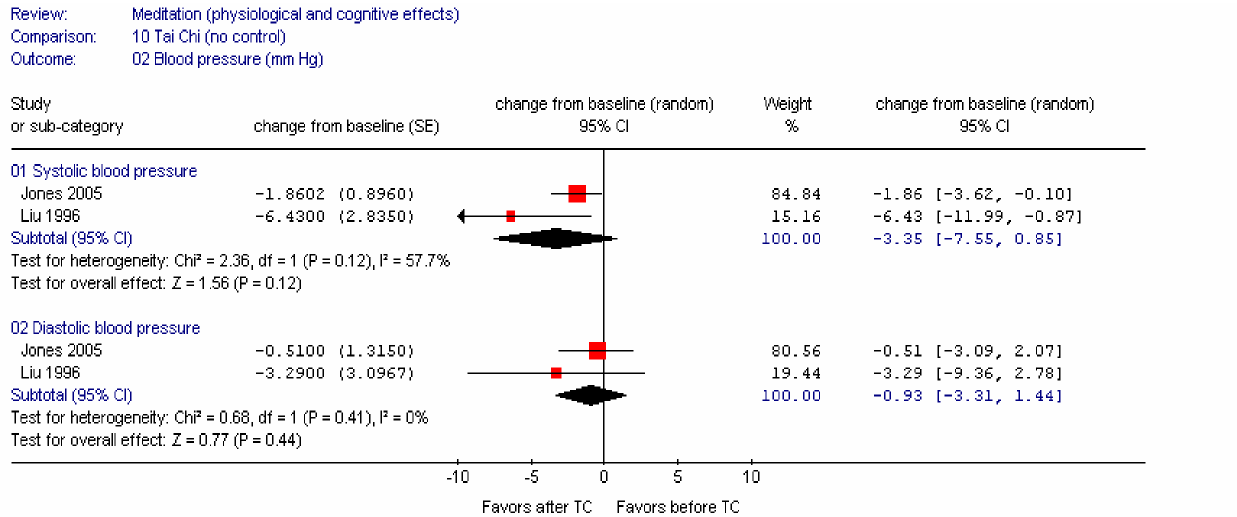
Figure 59. Meta-analysis of the effect of Tai Chi (no control) on heart rate



Blood pressure. Two studies[296,317] totaling 74 participants provided data on the effect of Tai Chi on blood pressure in healthy populations (Figure 60). The combined estimate of changes in SBP (mm Hg) indicated a small, nonsignificant improvement (reduction) favoring Tai Chi (change from baseline = -3.35; 95% CI, -7.55 to 0.85). There was evidence of heterogeneity between the studies regarding change from baseline ($p = 0.12$; $I^2 = 57.7$ percent).

The combined estimate of changes in DBP (mm Hg) also showed a small, nonsignificant improvement (reduction) favoring Tai Chi (change from baseline = -0.93; 95% CI, -3.31 to 1.44). The study results were homogeneous (p = 0.41, I^2 = 0 percent). Though there were differences between the studies regarding the age of participants (mean ages respectively 53 ± 10 years and 22 ± 3 years) and proportion of males to females (1:5 and 1:1), it is unlikely that these are the sources of the discrepancy in the measures of heterogeneity for SBP and DBP results. As a result, it is unclear what clinical differences may be responsible for the discrepancy.

Figure 60. Meta-analysis of the effect of Tai Chi (no control) on blood pressure



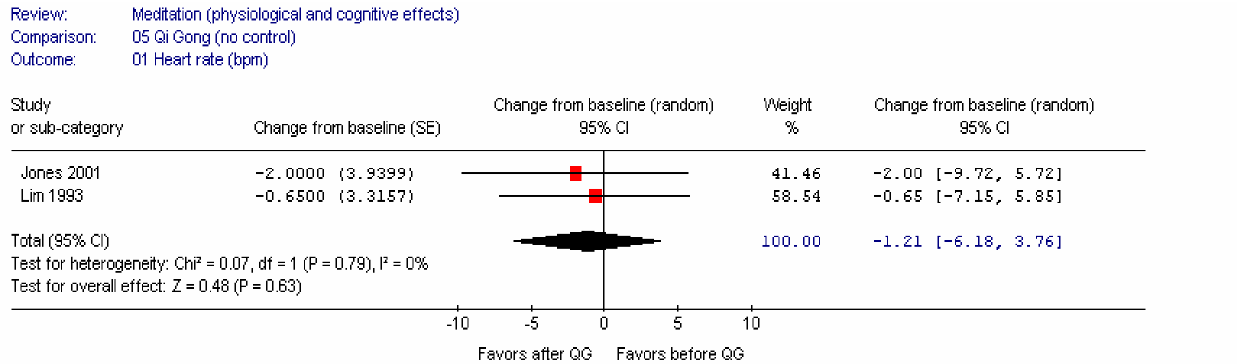
Qi Gong

Two before-and-after studies that assessed the effect of Qi Gong on physiological outcomes were identified.[191,299]

Qi Gong (no control)

Heart rate. Two studies[191,299] totaling 29 participants assessed the effect of Qi Gong on heart rate in healthy populations (Figure 61). The combined estimate in changes in heart rate (bpm) indicated a small, nonsignificant improvement (reduction) after practicing Qi Gong (change from baseline = -1.21; 95% CI, -6.18 to 3.76). The study results were homogeneous (p = 0.79, I^2 = 0 percent).

Figure 61. Meta-analysis of the effect of Qi Gong (no control) on heart rate



Summary of the Results

Overall, 311 studies evaluated the physiological and neuropsychological effects of meditation practices. The majority of studies used an RCT design (54 percent) and Yoga was the most common intervention (35 percent) that was studied. The overall methodological quality of all studies was low with only one study[168] considered high quality. The majority of studies were of short and medium duration.

Data from 53 studies (20 RCTs, 8 NRCTs, 25 before-and-after) were considered for direct meta-analysis to provide an evaluation of the effects of TM®, RR, Yoga, Tai Chi, and Qi Gong. The intervention groups were compared variously against BF, exercise, free breathing, medication, NT, WL, and UNB. Outcomes suitable for meta-analysis included blood pressure (SBP and DBP), heart rate, total cholesterol, respiratory rate, fasting blood glucose, and galvanic skin resistance. The majority of studies used healthy participants (45 studies) as the comparison group; people with type II DM and with essential hypertension comprised the only other study populations (six studies and four studies, respectively). All results below apply to healthy populations unless otherwise indicated.

Transcendental Meditation®

Direct meta-analysis showed that compared to NT, TM® did not produce significantly greater benefits on blood pressure (SBP and DBP). However, there was significant improvement in LDL-C levels and verbal creativity with TM®. When compared to WL, TM® produced significantly greater reduction in SBP and DBP. Before-and-after studies on TM® for patients with essential hypertension indicated a statistically significant reduction in SBP and DBP after practicing TM®. The heterogeneity present for the comparisons evaluating blood pressure changes and cortisol levels suggests that there were important clinical differences among the studies; however, the small number of studies precluded subgroup analyses.

Relaxation Response

The results of meta-analysis showed that compared to BF, RR did not produce significantly greater reduction in muscle tension. When RR was compared to a condition of rest, the rest group showed a significantly greater reduction in heart rate.

Yoga

When compared to NT, Yoga did not show a significantly greater benefit in lowering SBP or DBP. When compared to exercise, Yoga did not significantly lower heart rate or increase oxygen consumption. Compared to URNB, ULNB showed no significantly greater benefit in reducing heart rate.

When compared to free breathing, Yoga (UNB) showed no statistically or clinically significant benefit in improving verbal or spatial ability test scores. Finally, when examined using a before-and-after design, practicing Yoga did not demonstrate a significant benefit decreasing heart rate. There was also no significant benefit for Yoga in increasing galvanic skin resistance, reduction of intraocular pressure, and reduction of fasting blood glucose in healthy populations. There was varied heterogeneity among studies combined for heart rate, respiratory rate, galvanic skin resistance, and intraocular pressure, suggesting important clinical differences among the studies.

Before-and-after studies showed a significantly greater benefit after practicing Yoga in reducing heart rate in hypertensive populations. In healthy populations, practicing Yoga demonstrated a significant benefit in reducing DBP. There was also indication that Yoga has significantly greater benefit in increasing breath holding time after inspiration and expiration, in decreasing visual reaction time, and in the reduction of intraocular pressure (two of four outcomes). There was varied heterogeneity between studies combined for heart rate in hypertensive patients, SBP, and fasting blood glucose in patients with type II DM, suggesting important clinical differences between the studies. The heterogeneity present in the results examining respiratory rate, auditory reaction time, intraocular pressure (two of four outcomes), and fasting blood glucose prevented calculating an overall estimate of effect and suggested important clinical differences between the studies.

Tai Chi

The results of studies that compared Tai Chi to NT were too heterogeneous to provide combined estimates for the effect of Tai Chi on heart rate and blood pressure. In addition, the small number of studies precluded a subgroup analysis.

When compared to exercise, Tai Chi showed no significantly greater reduction in SBP, but did indicate a significant benefit in the reduction of DBP. In before-and-after studies, there was no significantr reduction in heart rate, SBP and DBP after practicing Tai Chi than before. Substantial heterogeneity was also present in this comparison and, as with NT, a lack of studies prevented a subgroup analysis.

Qi Gong

Qi Gong did not significantly reduce heart rate in elderly populations, nor did it significantly reduce SBP and DBP in healthy populations.

There were 22 outcome measures on the physiological and neuropsychological effects of meditation practices for which a combined estimate could be produced with little or no statistical heterogeneity. The comparisons, overall effect estimate, and statistical and clinical significance of each is outcome is summarized in Table 44.

Statistically and clinically significant changes in healthy participants were produced by TM® for heart rate, DBP, and LDL-C (TM® versus NT), and for SBP and DBP (TM® versus WL). The increase in verbal creativity (SMD = 0.74; TM® versus WL) is also statistically significant, but it is unlikely that this change would be clinically meaningful. In contrast, the change in SBP (TM® versus NT) was not statistically significant; however, the effect estimate suggests a clinically meaningful reduction of 5.24 mm Hg. When compared to rest, RR was more effective at reducing heart rate. However, though statistically significant, the change suggested by the overall effect estimate is unlikely to be clinically meaningful.

Statistically and clinically meaningful changes were produced in healthy participants by the practice of Yoga for breath holding (18 and 14 breaths/minute) and DBP (-6.22 mm Hg). There was a significant reduction in heart rate in hypertensive patients (-7 bpm); however, the clinical significance of this change depends on the baseline measures of the population for which the intervention is being considered. All the changes described above were observed in studies using a before-and-after design, a design that is unable to control for a host of extraneous variables that may bias the study results (e.g., temporal trends, regression to the mean, and sensitivity to design parameters) and potentially overestimate the effect of the intervention. Therefore, any causal claim about the effect of the intervention should be considered in light of these methodological shortcomings and caution should be exercised when interpreting these results.

The overall effects of Yoga based on RCTs and NRCTs indicate that this practice does not produce significant changes in healthy populations in oxygen consumption, spatial ability, SBP, DBP, or fasting glucose.

When Tai Chi was compared to exercise, there was a statistically significant reduction in DBP; however, the change was not clinically significant (0.83 mm Hg). No significant change was observed in SBP. Before-and-after studies on Tai Chi did not indicate a clinically significant change in either SDP or DBP; however, these results should be interpreted in light of the stronger evidence available from the two combined RCTs. Likewise, no statistically or clinically significant changes in heart rate were produced by the practice of Qi Gong. Nevertheless, this result is based on before-and-after studies and the result should be considered carefully in light of the methodological difficulties described previously.

Finally, the low methodological quality of all the studies included in the meta-analysis is an additional cause for interpreting all the results described here with caution.

Table 44. Summary of statistical and clinical significance of physiological outcomes examined in clinical studies on meditation practices

Comparison	Outcome	Statistical significance	Clinical significance
TM® versus NT	SBP	Medium and long term WMD = -5.24; 95% CI, -12.85 to 2.37 **TM® no better than NT**	Yes
	DBP	Medium and long term WMD = -5.19; 95% CI, -10.24 to -0.13 **TM® better than NT**	Yes
	LDL-C levels	Long term WMD = -23.94; 95% CI, -43.87 to -4.00 **TM® better than NT**	Potentially, depending on initial LDL level and risk factors
	Verbal creativity	SMD = -0.74; 95% CI, -1.12 to -0.36 **TM® better than NT**	No
TM® versus WL	Heart rate	WMD = -5.94; 95% CI, -11.54 to -0.35 **TM® better than WL**	Potentially
	DBP	WMD = -3.61; 95% CI, -6.62 to -0.59 **TM® better than WL**	No

DBP = diastolic blood pressure; LDL-C = low-density lipoprotein cholesterol; NT = no treatment; RR = Relaxation Response; SBP = systolic blood pressure; SMD = standardized mean difference; TM® = Transcendental Meditation®; ULNB = unilateral left nostril breathing; URNB = unilateral right nostril breathing; WL = waiting list; WMD = weighted mean difference

Table 44. Summary of statistical and clinical significance of physiological outcomes examined in clinical studies on meditation practices (continued)

Comparison	Outcome	Statistical significance	Clinical significance
RR versus rest	Heart rate	WMD = 2.56; 95% CI, 1.32 to 3.80 **RR not as good as rest**	No
Yoga versus exercise	Oxygen consumption	WMD = 1.91; 95% CI, -0.48 to 4.31 **Yoga no better than exercise**	No
Yoga versus Free breathing	Spatial ability	Left nostril: SMD = 0.24; 95% CI, -0.34 to 0.43 Right nostril: SMD = 0.05; 95% CI, -0.34 to 0.43 **Yoga no better than free breathing**	No
Yoga versus NT	SBP	WMD = -8.10; 95% CI, -16.94 to 0.74 **Yoga no better than NT**	Yes
	DBP	WMD = -6.09; 95% CI, -16.83 to 4.64 **Yoga no better than NT**	Yes
Yoga (ULNB) versus URNB	Heart rate	WMD = -2.12; 95% CI, -4.41 to 0.17 **Yoga (ULNB) no better than URNB**	No
Yoga (no control)	Breath holding time after inspiration	Change from baseline = -18.85; 95% CI, -22.64 to –15.05 **Significant change after practicing Yoga**	Potentially
	Breath holding time after expiration	Change from baseline = -14.53; 95% CI, -16.82 to -12.24 **Significant change after practicing Yoga**	Potentially
	Heart rate (hypertensives)	Change from baseline = -6.79; 95% CI, -9.97 to -3.60 **Significant change after practicing Yoga**	No
	Fasting blood glucose (healthy)	I: Change from baseline = -3.71; 95% CI, -7.52 to 0.11 II: Change from baseline = -3.77; 95% CI, -7.80 to 0.27 III: Change from baseline = -3.64; 95% CI, -7.92 to -0.64 IV: Change from baseline = -3.81; 95% CI, -7.97 to -0.35 **No significant change after practicing Yoga**	No
	DBP	Change from baseline = -6.22; 95% CI, -7.73 to -4.70 **Significant change after practicing Yoga**	Yes
Tai Chi versus exercise	SBP	(WMD = 1.79; 95% CI, -0.82, 4.41 **Tai Chi no better than exercise**	No
	DBP	(WMD = 0.83; 95% CI, 0.18 to 1.48) **Tai Chi better than exercise**	No
Tai Chi (no control)	SBP	Change from baseline = -3.35; 95% CI, -7.55 to 0.85) **No significant change after practicing Tai Chi**	No
	DBP	(Change from baseline = -0.93; 95% CI, -3.31 to 1.44) **No significant change after practicing Tai Chi**	No
Qi Gong (no control)	Heart rate	Change from baseline = -1.21; 95% CI, -6.18 to 3.76 **No significant change after practicing Qi Gong**	No

Chapter 4. Discussion

The Practice of Meditation

Five broad categories of meditation practices were identified in the included studies: Mantra meditation (comprising TM®, RR, and CSM), Mindfulness meditation (comprising Vipassana, Zen Buddhist meditation, MBSR, and MBCT), Yoga, Tai Chi, and Qi Gong. One of the objectives of this review was to provide a descriptive overview and synthesis of information on meditation practices in terms of their main components, the role of spirituality, training requirements, and criteria for success. It is important to emphasize that the review on Topic I does not constitute a manual for any meditation practice. A more detailed explanation of any specific meditation practice described in this report should be sought in specialized texts or from master practitioners.

Given the variety of the practices and the fact that some are single entities (TM®, RR, and CSM, Vipassana) while others are broad categories that encompass a variety of different techniques or combination of practices (Yoga, Tai Chi, Qi Gong, MBSR, and MBCT), it is impossible to select components that might be considered universal or supplemental across practices. Though some statement about the use of breathing is universal among practices, this is not a reflection of a common approach toward breathing. The control of attention is putatively universal; however, there are at least two aspects of attention that might be employed and a wide variety of techniques for anchoring attention. The spiritual or belief component of meditation practices is poorly described in the literature and it is unclear in what way and to what extent spirituality and belief play a role in successful practice. The amount of variation in the described frequency and duration of practice make it difficult to draw generalizations about the training requirements for meditation practices. The criteria for successful meditation have also not been described well in the literature, though this may reflect the attitude that meditation is successful if one simply does it. At a clinical level, it might be argued that meditation is successful if it produces positive outcomes.

Demarcation

Providing a comprehensive review and summary of the scientific research on meditation practices requires the development of appropriate criteria by which to distinguish meditation practices from nonmeditation practices (what Ross[327] has called a "demarcation criterion"). The development of such criteria is one of the most difficult yet important components of research on meditation practices,[12] yet there is currently no consensus on a definition of meditation[12] or on a way to classify the variety of meditation practices.[12,37] Researchers have attempted to identify the components essential to the practice of meditation and to classify meditation practices in various ways:

- any procedure that uses: (1) a specific, clearly defined technique, i.e., a "recipe" for meditation; (2) muscle relaxation in some moment of the process; (3) "logic relaxation"; (4) a self-induced state; and (5) a "self-focus" skill, or anchor;[9]

- a discrete and well defined experience of "thoughtless awareness.[12,125] Techniques that fail to provide the key experience of mental silence or thoughtless awareness, including techniques that use constant repetition of syllables, visualizations, or other thought forms are considered "quasi-meditation;[12]
- techniques that seem to restrict awareness to a single, unchanging source of stimulation for a definite period of time;[328]
- an exercise in which the individual turns attention or awareness to dwell upon a single object, concept, sound, image, or experience, with the intention of gaining greater spiritual or experiential and existential insight, or of achieving improved psychological well-being;[34] and
- a family of self-regulation practices that focus on training attention and awareness in order to bring mental processes under greater voluntary control and thereby foster general mental well-being and development and/or specific capacities such as calm, clarity, and concentration.[10]

Even if most investigators would agree that meditation implies a form of mental training that requires either stilling or emptying the mind to achieve a state of "detached observation," few seem to consider this a sufficient demarcation criterion. Also, the general definitions offered above appear to be too narrow, excluding awareness-based forms of meditation such as Vipassana, MBSR, MBCT, and Zen Buddhist meditation.

Definitions usually focus on the phenomenological aspects of meditation practice and, with the exception of Cardoso et al.,[9] rarely describe the necessary practical and physical components in sufficient detail to be translated into an operational definition of meditation. Further, though some investigators believe that research has shown meditation to be clearly distinguished from relaxation,[3] as Manocha[12] notes, there is sufficient evidence to show that "quasi-meditation," techniques that do not cultivate a state of mental silence, do not differ from rest in terms of their physiological effects. Such results, if valid, make the development of clear demarcation even more important. This review has not evaluated whether meditation is indeed different from relaxation.

Whether defining meditation by one criterion or more, most investigators have looked for necessary and sufficient conditions with which to demarcate meditation practices from nonmeditation practices. Surprisingly, despite a persistent lack of consensus and the fact that demarcation criteria need not be bound by this approach,[327] no author has examined alternative approaches to defining meditation despite some well-known developments in methods of demarcation in the philosophy of language[329] and cognitive psychology,[330] and more recent developments in ethics[331] and evolutionary biology.[332,333] Applying some of these techniques to meditation may prove fruitful.

Classification

To our knowledge, this is the first systematic examination of the components of and training for individual meditation practices.[125] Classification of meditation practices is frequently based on the direction of attention,[334] e.g., "opening up" versus "turning off,"[328] positive versus negative,[9] mindful versus concentrative,[3] directive versus nondirective,[335] etc. However, it has been suggested that the concentrative forms should not be viewed as opposites to the mindful or negative forms, but as the first step toward a progressive refinement of attention and concentration.[335] Several practices in Yoga and Qi Gong will fall into both categories. Meditation practices may also be classified according to their historical origins with Indian and Chinese forms constituting two groups and clinically-based practices another.[334]

We employed consensus techniques to develop an extensive, though not exhaustive, list of 32 common meditation practices. The categories of meditation practices we have employed reflect only those practices identified in the English-language scientific literature and that satisfied the inclusion criteria for this review. There is a noticeable gap in the research that has been conducted on meditation practices—of the 32 practices identified in the Delphi process, only the 10 described here (TM®, RR, CSM, Vipassana, Zen Buddhist meditation, MBSR, MBCT, Yoga, Tai Chi, and Qi Gong) have been assessed in trials or using a before-and-after design. It is unlikely that our literature search failed to uncover a broad category of practices, though we may have missed certain practices, for example, techniques purportedly used by indigenous peoples of North America.[34] However, given the comprehensiveness of our literature search strategy, it is unlikely that such practices, if subjected to scientific inquiry, would have been missed.

The categories are only meant to be descriptive and conclusions have not been made on the basis of the broad categories, but at the level of individual practices. Despite this, it may be that we have not sufficiently distinguished between schools of Tai Chi and style of Yoga and that distinct techniques have been subsumed under one category or class of practice. This lack of specificity will have affected the results of our analysis in cases where, for example, two styles of Tai Chi (e.g., Wu and Chang) have been combined. However, this potential limitation should serve to highlight the need for more explicit descriptions of techniques and the need for studies on a wide range of techniques for similar health conditions.[336]

The broad categories we have employed can be criticized as being simplistic and as ignoring subtle differences among practices. However, the categorization of practices is a product of the typological divisions one makes. For example, we have chosen to class together TM® and RR, even though some may argue that there are sufficient differences between these two mantra meditation techniques to keep them separate. In addition, though Benson's[68] original formulation of RR clearly falls within the category of mantra meditation, contemporary formulations of the technique are multifaceted and incorporate a body scan, which is a mindfulness meditation technique (Dr. Jeffrey Dusek, personal communication, December 2006). Some may contend that RR and TM® should not be classed together because during TM® one does not try to associate the mantra with the breath, or dissociate the breath from the mantra, but rather the mantra is favored. There may be other subtle differences between practices grouped together in the broad categories. The difficulty in categorizing practices and the dearth of detailed descriptions in the literature reinforce the need for detailed descriptions of all components of the interventions employed in efficacy and effectiveness studies.

Universal Components of Meditation Practices

The results of this review are similar to those of a study by Koshikawa et al.[334] that examined the physical components of 12 different types of meditation practices (excluding Tai Chi and including Christian meditation practices, early Buddhist meditation, Ajikan meditation, and Hotei meditation) in order to determine what similarities, if any, existed among the practices. Using a survey methodology, the investigators questioned 12 experts (one for each type of meditation practice) regarding the environmental conditions required for practice, method of breathing, postures, body movement, use of mantra, object of attention, diet, and training requirements for mastery of the technique. Their results indicate that, though some meditation practices may share some features in common, no two practices are alike in all features and no features of practice are universal to them.

Complexity

The complexity of meditation practices makes dissecting components difficult and questionable; components may be synergistic and imperfectly understood if artificially separated from the whole discipline within which they take place.[328] For example, though we have noted that no practice of a meditative technique requires the adoption of a particular belief system, West[34] has questioned the reliance of researchers on clinically standardized forms of meditation practice rather than examining meditation as a practice that may be inextricably bound up with belief systems and expectations and ignoring the use of meditation as a central component of the belief system and of the day-to-day life of the practitioner. Other researchers have noted that the specific components adopted in a given meditation practice depend on the desired outcome,[116,128,129,334] a fact which may make finding the common components across several practices undesirable unless the same outcome can be achieved. In addition, different techniques are reported to have different effects, so even if subjective descriptions of two or more techniques make them appear similar, their similarity must still be rigorously assessed.

In addition, for some of the practices that involve movement (Tai Chi and some yogic and Qi Gong techniques), researchers face additional challenges in designing studies that can separate the effects of exercise from the effects of the meditation practice. As physical activity has been shown to produce beneficial effects in those same physiological and neuropsychological outcomes of interest in trials on meditation practices (e.g., blood pressure, mood, etc.), this type of research is particularly important if the benefits of meditation practices are to be accurately assessed.

Criteria of Successful Meditation Practice

No descriptions of meditation practices provided an explicit statement of the criteria for successful meditation practice beyond reference to the internal states of the practitioner. The criteria have generally been inferred from descriptions of the practice. For example, in TM® the practitioner attends a series of checkup meetings in which their technique is examined, implying that the adequacy of the technique is judged by an experienced practitioner. However, there is no statement that individual practitioners cannot assess the correctness of their technique themselves and no list of the components that an experienced teacher may be attending to in assessing the practice. The same is true of Zen Buddhist meditation. Because of this method, there may be some inconsistencies in the criteria for successful practice. However, this does not change the fact that there is a dearth of information on the determination of successful meditation practice and that this is an area in which future studies may improve.

Training

Some overviews of meditation practices[328] have provided descriptions of the training requirements for meditation. However, these descriptions have focused mainly on TM®, Zen Buddhist meditation, and some yogic practices, and they fail to capture the wide range of training practices suggested by our literature review. In addition, poor descriptions of the physical aspects of the meditation techniques and the requisite training hinder identifying the components that may be similar across practices and limit the proper construction of and comparison between studies on the effectiveness of specific meditation practices. Without a detailed knowledge of, for example, an adequate training period for a particular Hatha yoga technique versus that for a Tai Chi technique, such studies are already confounded by factors pertaining to the learning of a technique and not the effects of the technique per se. In addition, some investigators[334] have found that if, as Naranjo[335] has observed, the development of the attitude specific to meditation is essential and the hardest part of meditation to attain and this can only be realized through practice, then proper instruction seems paramount and a description of the proper duration and frequency of any given technique is crucial to designing and appraising such studies.

State of Research on the Therapeutic Use of Meditation Practices in Healthcare

We have summarized a vast body of evidence regarding a broad group of practices categorized under the umbrella term "meditation". Some may argue that addressing a research question regarding the effects of "meditation on healthcare" would be as challenging as reporting on the effects of "medication on healthcare" (Personal communication, David Shannahoff Khalsa, May 2007). There were substantial variations among the studies in the description of the practices of meditation, the type of controls, the type of populations, and the outcomes reported.

The field of scientific research on meditation practices does not appear to be organized under a shared theoretical framework, but instead consists of distinct groups of investigators working within different approaches of treatment theory (e.g., physiological, cognitive, behavioral, and cognitive-behavioral) that fail to engage each other meaningfully.

The majority of studies on meditation practices identified in this review have been conducted in Western countries and published as journal articles within the past 15 years. The majority of research in meditation practices has been conducted as intervention studies (67 percent), with 49 percent being RCTs or NRCTs. A similar bibliometric analysis on the clinical application of Yoga has revealed an increase in publication frequency over the past three decades with a substantial and growing use of RCTs.[337]

We identified and excluded from the review a considerable number of multiple publications (n = 108). In some instances, the same study was published in two separate journal articles without full cross reference, a practice of redundant publication that has been considered scientific misconduct.[338-340] Including redundant publications in systematic reviews and meta-analyses increases the risk of overestimating the effect size. The problem of redundant publications has not yet been sufficiently explored in the scientific literature; therefore, it is unknown how the proportion of redundant publications in meditation research compares to other areas of scientific inquiry. Authors of future studies on meditation should avoid redundant publications and must adhere to guidelines for good publication practices.[340]

Quality of the Evidence

Overall, we found the methodological quality of meditation research to be poor, with significant threats to validity in every major category of quality regardless of study design. Observational studies accounted for 33 percent of all the studies in the review. This type of study is open to several forms of systematic error such as selection bias, detection bias, and attrition bias. Intervention studies that used designs with pre-post treatment comparisons within the same group (known as single group before-and-after studies or uncontrolled trials) are not as rigorous as designs that use between-group comparisons because they do not allow investigators to determine whether the results are due to the meditation practice or to other factors. Studies with stronger designs such as RCTs and NRCTs allow a greater sense of confidence in study results; however, we found the quality of reporting to be poor for most of the intervention studies included in the review. This finding is not unique to the area of meditation research, and quality of reporting is a frequent problem in other areas of complementary and alternative medicine (CAM) research.[341]

The publication of the Consolidated Standards of Reporting Trials (CONSORT)[342] statement in 1996 was aimed at the improvement of the quality of research reports of RCTs. It is unknown how the quality of reporting of RCTs of meditation practices has changed after the dissemination of CONSORT in the CAM community, but it is noteworthy that only 20 percent of the RCTs identified in the review described how the randomization was carried out, 8 percent were described as double-blind, and 4 percent described how they concealed the allocation.

The lack of double-blind RCTs has been a controversial topic not only in meditation research, but also in other areas of CAM,[343] surgical interventions,[344] and behavioral treatments.[345] Some authors have called for a "paradigm shift," suggesting that the quality of CAM research should be evaluated by other methodological standards. Some commentators have argued that the placebo-controlled trial is not a valid or fair method for evaluating CAM treatments.[346-348] Specifically, it is claimed that the scientific techniques of treatment protocols, randomization, double-blind conditions, and use of placebo controls distort the "holistic" therapeutic milieu of CAM. However, the notion of "holistic" interventions as opposed to "conventional medicine" may be an artificial misconception. Just as CAM does, traditional interventions provide treatments within a symbolic healing context by using "nonspecific" therapeutic attention and expectations.[349]

There is little argument against the idea that RCTs provide the least biased method for finding a reliable answer on the effectiveness of any therapeutic intervention, including CAM practices such as meditation. Based on empirical evidence and theoretical considerations, there are some basic characteristics that should always be considered when evaluating the quality of an RCT: randomization, blinding, handling of patient attrition in the analysis, and allocation concealment.[40,42,350,351]

Some authors have supported the idea that "those who insist that the evidence to support complementary and alternative medicine can legitimately be softer than in mainstream medicine will have to reconsider their position. Double standards in medicine existed for many years; undoubtedly they still exist today, but hopefully their days are numbered."[352]

Double-blinding of the instructor and participant to treatment in meditation studies is often infeasible, a consequence of the fact that instructors must apply a specially learned skill in a particular therapeutic context (e.g., with clinically depressed patients). However, double blinding is still possible because the difficulties in blinding the experimenter can be circumvented by blinding the participants using a sham procedure such as similar attention control intervention or a placebo with a different mode of administration (as it has been done in psychotherapy research) and by blinding them to the hypothesis, and by blinding the outcome assessors to the nature of the intervention and the hypothesis. In cases where the comparison is an active treatment and blinding of participants to the treatment is impossible, it may still be possible to blind participants to the research hypothesis to minimize expectancy bias. Therefore, research on CAM should adhere to the same methodological requirements for all clinical research, and randomized, placebo-controlled clinical trials should be used for assessing the efficacy of CAM treatments whenever feasible and ethically justifiable.[353]

When double blinding was assessed using an individual components approach, we found that, although the vast majority did not use double blinding to hide the identity of the assigned interventions (97 percent), a small but promising percentage reported the use of double-blind procedures. The idea that it is possible to design high-quality trials in meditation and implement double-blind procedures by selecting appropriate control groups is gaining support in meditation research. We agree with other researchers that the implementation of these trials in any area of CAM research, including meditation, require much more preparation than trials of pharmacological interventions, and components such as blinding procedures, selection of credible placebos, and consistency of inherently individualized interventions are challenging issues that need extensive evaluation.[343]

Our conclusion here is that the idea that “due to the nature of meditation, it is impossible to double blind meditation practices” has been used as an excuse to justify the overall low quality of research that characterizes this body of evidence. However, the over emphasis of the “double-blinding” issue does not hide the fact that 95 percent of the studies failed to describe how they concealed the allocation to the interventions under study or the fact that overall, only 20 percent of the trials described the procedures of randomization, and that only half described study dropouts.

Therefore, syntheses of the results from studies included in this review should be interpreted with caution due to the serious threats to theinternal validity of the included studies.

Types of Interventions

Although a relatively small group of meditation practices have been studied in the scientific literature, they vary in many respects. There was a remarkable heterogeneity across the studies regarding the description of the characteristics and implementation of the practice even within the same type of meditation. Differences in theoretical assumptions underlying the practices of meditation may explain why studies conducted on similar meditation practices often differed in the potential benefits that were assessed. Some authors have declared that meditation poses a considerable challenge for the principles of evidence-based medicine.[17] Meditation is a complex and multifaceted intervention, difficult to standardize, and for which specific effects are hard to distinguish.[17] It is important, therefore, that investigators make an effort to avoid the excessive heterogeneity that characterizes this field, by clearly defining and reporting the intervention procedures of the meditation practice under scrutiny.

Types of Control Groups

Control groups are essential for the valid evaluation of the effects of meditation practices; however, the problem of the inadequacy of control groups in meditation research is not new.[354] Almost half of the RCTs and NRCTs have used WL or no treatment approaches for the control group rather than a comparator that would more fully control for the variety of influences that may bias the results including expectancy effects, social interactions, attention given by instructors, and time spent in the practice. Some authors have argued that the use of WL as a control group is clearly inappropriate as no one expects to improve while they are waiting to begin treatment. This situation may create a negative expectation of improvement that may spuriously amplify the difference in treatment effect between the intervention and the control.[345] Therefore, caution should be exercised when interpreting studies comparing the effectiveness of meditation practices to no treatment or WL.

A wide array of active control groups were used in the intervention studies on meditation practices. Active controls included exercise and other physical activities, states of rest and relaxation, educational activities, PMR, cognitive behavioral techniques, pharmacological interventions, psychotherapy, biofeedback techniques, reading, hypnosis, therapeutic massage, acupuncture, and other meditation techniques.

The results of this review show that the control groups employed in meditation research are many and various, and it is unknown how comparable they are across studies. Meditation practices are disparate with regard to specific components, and there is the potential for well-designed studies to employ disparate control groups. Authors of future studies need to design control groups with a clear vision of the research question and the hypothesized mechanism and full consideration of how threats to validity may be best addressed for a given meditation practice.

Types of Study Populations

The vast majority of studies on the effects of meditation practices have been conducted in healthy populations as compared to clinical populations. It can be argued that studies of healthy individuals are useful to assess how meditation practices prevent certain clinical conditions and enhance wellness and well-being. However, studying the therapeutic effects of meditation practices in a healthy population does not provide a clear picture of their effectiveness as therapeutic interventions in healthcare. Clinical studies of meditation practices have addressed conditions with high mortality and morbidity rates, or burden of disease including hypertension, cardiovascular disorders, substance abuse, anxiety disorders, cancer, asthma, chronic pain, type II DM, and fibromyalgia. The first three conditions were among the six leading sources of premature death and disability in the United States in the mid-1900s and are projected to continue to be so to the year 2020, as measured by disability-adjusted life years (DALYs).[355,356]

Types of Outcome Measures

Studies varied widely in their use of outcome measures. Outcomes of physiological functions, particularly cardiovascular measures, were the most frequently studied. Psychosocial outcomes (i.e., psychiatric and psychological symptoms, measures of personality and positive outcomes) and outcomes related with clinical events were also frequently assessed. Compared to physiological and psychosocial outcomes, little has been explored on cognitive and neuropsychological functions. Some authors have argued that relatively gross outcomes such as physiological measures have taken prominence in meditation research.[354] However, considering that the close interdependence of the mind and body should be taken into account when evaluating the responses to meditation practices, more subjective and experiential variables[354] are paramount to evaluate the effects of these mind-body techniques.

Evidence on the Efficacy and Effectiveness of Meditation Practices

We have summarized the evidence regarding the efficacy and effectiveness of meditation practices for the three most studied conditions in the scientific literature: hypertension, cardiovascular diseases, and substance abuse.

We conducted a series of direct and indirect meta-analyses comparing a variety of meditation practices versus a comparison group in hypertensive patients. We provided pooled estimates for the following comparisons: TM® versus HE, TM® versus PMR, RR versus BF, Qi Gong versus WL, Yoga versus NT, Yoga versus HE, and Zen Buddhist meditation versus blood pressure checks.

A few studies of poor methodological quality were available for each comparison, mostly reporting nonsignificant results (TM® had no advantages over HE to improve measures of SBP, DBP, body weight, heart rate, stress, anger, self-efficacy, cholesterol, dietary intake, and level of physical activity in hypertensive patients; RR was not shown to be superior to BF in reducing blood pressure in hypertensive patients; Yoga did not produce clinical or statistically significant effects in blood pressure when compared to NT; Zen Buddhist meditation was not better than blood pressure checks to reduce SBP in hypertensive patients; Yoga was not better than physical exercise to reduce body weight in patients with cardiovascular disorder. When indirect meta-analysis was used, we did not find differences between MBSR and Yoga to control anxiety symptoms in cardiovascular patients. It is unknown whether these are truly “negative findings” (i.e., one cannot say that there is evidence of no effect) or if there is a lack of power to detect a statistically significant result due to the low number of studies included in the meta-analyses (i.e., we can say that there is no evidence of effect).

A few statistically significant results favoring meditation practices were found: both TM® versus PMR, and Qi Gong versus WL for DBP and SBP, Zen Buddhist meditation versus blood pressure checks for DBP, and Yoga versus HE to reduce stress. The positive results from these meta-analyses need to be interpreted with caution, as biases, such as expectancy bias, cannot be excluded.

For the majority of the comparisons, meta-analyses were derived from only two open-label trials; therefore, performance bias and detection bias may have contributed to an overestimate of the treatment effect. In some instances, the appropriateness of the comparison group was questionable (e.g., Qi Gong versus WL)

Other reviews have summarized the evidence on the effects of Tai Chi in hypertension, and on TM® for hypertension, cardiovascular diseases, and substance abuse. Differences in selection criteria and review methods preclude a direct comparison of the results among the reviews.

Wang et al.[29] assessed the evidence on the effects of Tai Chi in hypertension and concluded that Tai Chi produces benefits in cardiovascular function. The review included evidence from two studies published in the non-English literature, and another study in a population of normal elderly, not individuals diagnosed with hypertension. Differences in the selection criteria of study participants and language of publication may explain the differences in the findings between Wang et al.[29] and our review.

Walton et al.[357] reviewed the literature on the effectiveness of TM® in the treatment or prevention of cardiovascular diseases and concluded that TM® produced reductions in blood pressure, carotid artery intima-media thickness, myocardial ischemia, left ventricular hypertrophy, mortality, and other relevant outcomes. The authors adopted a qualitative approach for the synthesis of the evidence. The Walton review[357] did not report on the use of systematic literature searches or on the assessment of the methodological quality of the evidence, but adopted a methodological approach where significant findings were emphasized within studies. Differences between Walton's conclusions and the results reported in our review may be due to differences in the methodological approaches to synthesize the evidence. We conducted comprehensive searches of the scientific literature and assessed the methodological quality of the trials. Our synthesis of the evidence combined a qualitative approach with quantitative meta-analytic methods that assessed mean treatment effects in relation to the between-study variability of treatment effects. Furthermore, differences in the selection criteria (i.e., type of participants, diagnostic criteria, publication year) for the inclusion of studies may also explain differences in the conclusions of the reviews.

Canter et al.[25] conducted a systematic review on the effects of TM® for blood pressure. Six trials were identified but only one evaluated the effect of TM® in hypertensive individuals, whereas the others were conducted in adults with normal blood pressure and adolescent populations. The authors concluded that there was insufficient good quality evidence to conclude whether or not TM® has a positive effect on blood pressure.

Evidence on the effects of TM® on substance abuse has been summarized in two reviews.[22,358] Alexander et al.[358] conducted a meta-analysis of 19 studies to provide a single estimate of treatment effect. The review included a variety of study designs such as cross-sectional studies, “retrospective studies,” “longitudinal studies,” and “experiments with random assignment.”[358] Effect sizes across studies were provided for categories of study designs (“well-designed” studies, cross sectional studies, and general population studies). Gelderloos et al.[22] conducted a review of 24 studies of TM® for preventing and treating substance abuse. The authors concluded that “taken together”, the studies demonstrate an improvement in psychosocial outcomes. The review did not use a systematic approach to select and appraise the literature and made no distinctions among the variety of study designs that were considered.

Other systematic reviews have synthesized the evidence on the efficacy and effectiveness of meditation practices for conditions other than hypertension, cardiovascular diseases, and substance abuse. However, it was beyond the scope of this report to examine conditions other than hypertension, cardiovascular diseases and substance abuse. Other systematic reviews have examined the effects of Tai Chi for a variety of medical diseases,[359] chronic conditions,[29] rheumatoid arthritis,[360] improvement of aerobic capacity,[361] and elderly populations.[362] Studies on the effects of Yoga in depression[145] and anxiety,[363]and MBSR on health status measures[18] and a variety of medical conditions[7] have been also reviewed. Finally, other reviews have assessed the effects of a variety of meditation practices such as Qi Gong in Chinese cancer patients,[364] RR in adult patients,[365] meditation therapy programs for anxiety disorders,[19] and the effects of TM® on cognitive function[23] and psychological health.[366]

It is expected that systematic reviews have heterogeneity in their results when they bring together studies that are both clinically and methodologically diverse.[367] Statistical and clinical heterogeneity constituted a frequent and considerable problem when pooling the results, and, in some cases, it precluded an effort to summarize data across the studies. Clinical heterogeneity was due to differences across the trials in the characteristics of study populations, the implementation of the meditation practice, outcome measurement, and followup period. Clinical heterogeneity may have explained why trials with different types of participants, interventions, or outcomes showed different effects. When statistical heterogeneity exists, pooled results are uncertain or conditional.[368]

The poor methodological quality of the trials limits the strength of inference regarding the observed treatment effects reported in this review and constitutes a possible shortcoming of the meta-analysis.[367] The lack of description of the methods of allocation concealment, randomization, description of withdrawals and dropouts per treatment group, the absence of double blinding the interventions, and the use of incompatible or inappropriate control groups undermine the results of many clinical studies. Therefore, researchers are advised against making firm statements regarding treatment effects based on the quantitative summaries reported in this review.

Some factors have impeded the scientific progress regarding the efficacy and effectiveness of meditation practices in healthcare. Few studies have described the meditation practices or control procedures in sufficient detail, which prevents a sensible analysis of the observed differences in treatment effects for some classes of meditation practices. Other limitations include insufficient information regarding the characteristics of the trainer's competence and experience, the lack of an accurate assessment of participants' expectancy, compliance and motivation, and the paucity of descriptions of the statistical power of the intervention effect.

Evidence on the Role of Effect Modifiers for the Practice of Meditation

The role of effect modifiers in the practice of meditation is a topic that has so far been neglected in the scientific literature. Evidence from RCTs and NRCTs regarding the interaction of meditation practices with other variables in populations of patients with hypertension, cardiovascular disorders, or substance abuse is scarce. A few studies conducted exploratory post hoc analyses (i.e., a subgroup analysis, multiple regression, or analysis of variance) that were intended to be hypothesis generating. Due to the small sample sizes in the studies, there were small numbers of subjects in each of the variable subgroups, lowering the power to detect any relationship with the outcomes produced by the practice of meditation. The lack of evidence on the role of effect modifiers has been pointed out by other authors.[17,354] Variables that may be important for the therapeutic effect of meditation practices include individual characteristics of the meditator, characteristics and training experience of the instructor, and the role of motivation and expectancy.[17,354]

Evidence on the Physiological and Neuropsychological Effects of Meditation Practices

We have summarized the evidence from RCTs, NRCTs and before-and-after studies regarding the physiological and neuropsychological effects of meditation practices. Our meta-analysis revealed that the most consistent and strongest physiological effects of meditation practices in healthy populations occur in the reduction of heart rate, blood pressure, and LDL-C. The strongest neuropsychological effect is in the increase of verbal creativity. There is also some evidence from before-and-after studies to support the hypothesis that certain meditation techniques decrease visual reaction time, intraocular pressure, and increase breath holding time. Though over half of the combined effect estimates are not statistically significant, the potential clinical significance of these estimates must be carefully considered. However, all of the studies included in the meta-analyses were of low methodological quality and, for this reason, the results should be interpreted cautiously.

Of the 311 studies reporting physiological and neuropsychological outcomes, only 53 (17 percent) were eligible for meta-analysis. Though small, this proportion is even smaller when one considers the 813 studies pertaining to research on the therapeutic use of meditation practices included in topic II. Some investigators have claimed that there are many empirical studies that have shown that meditation practices are effective at treating stress-related states,[4] including reducing heart rate, breathing, and blood pressure. In addition, previous literature reviews have noted the seemingly large number of research papers that purport to show the therapeutic benefit of meditation practices.[25,113,157,359,369] This review has shown that there are startlingly few scientific studies that could be statistically combined to provide evidence on the physiological and neuropsychological effects of meditation practices. While other investigators have noted the need for rigorous meta-analyses of the therapeutic use of meditation practices,[3,369] to our knowledge there are only two previous English-language meta-analyses[361,369] that examine the physiological effects of meditation practices and none examining the cognitive or neuropsychological effects. However, the two meta-analyses cover neither the range of meditation practices examined here nor the breadth of outcomes.

The clinical and methodological diversity of the studies make estimating the effects of meditation practices difficult. This difficulty is reinforced when one considers that 25 of the 44 (57 percent) outcome measures examined in the analyses had levels of heterogeneity that suggest important clinical differences between the studies. In addition, 8 of these 25 (32 percent) had heterogeneity measures greater than 80 percent, making overall effect estimates unwise because the implied clinical among study populations would render the overall estimates spurious.

The overall low methodological quality of the studies indicates that most suffered from methodological problems that may produce overestimations of the treatment effects or compromise the generalizability of the study results. Empirical evidence has demonstrated that trials “that were not double blinded yielded larger estimates of treatment effects compared with trials in which authors reported double blinding (odds ratios exaggerated, on average, by 17 percent)”.[40,370] Though difficult to do in studies on meditation practices, appropriate blinding is a special source of concern where an expectation of the efficacy of the practice under study on the part of the subject and assessor may bias outcome measures.

The low rate of reporting of withdrawals and dropouts and the reasons for dropping out are also of concern because this makes the assessment of the comparability between the intervention and control groups difficult. An additional concern is that patients who drop out may differ in important ways from those who complete the meditation regimen (e.g., being favorably predisposed to meditation practice), but, without adequate reporting, these differences remain hidden and their effects on outcomes remain unknown.

Regarding the predominant use of healthy subjects in the included studies, though of benefit for ascertaining the physiological and neuropsychological effects of meditation practices in this group, the use of healthy subjects limits the generalizability of the findings and provides information that is unlikely to be of use to clinicians who normally treat patients with specific health conditions.

Finally, the results of this meta-analysis indicate that research on the effects of meditation practices has been hindered by the use of weak study designs, specifically before-and-after studies (also known as single group pretest-postest designs and uncontrolled trials). Although the before-and-after study is simple and practical, it has been argued that results from such study designs be considered circumstantial evidence,[371] that is, hypothesis generating for further research using more rigorous study designs. The lack of a concurrent control group and the resulting inability to control for temporal trends, regression to the mean, and sensitivity to methodological features make it difficult to ascertain the true causal effect of a meditation practice. Clinical outcomes—whether good or bad—may be a result of factors other than the practice of meditation. For this reason, the estimates of the physiological and neuropsychological effects of meditation practices that are made on the basis of single-group studies should be considered carefully.

Strengths and Limitations

This evidence report is a systematic and comprehensive review of the indexed scientific literature available on the effectiveness of meditation practices supplemented by a search for relevant gray literature, abstracts from scientific meetings, dissertations and theses, reference lists, and trial registries. As noted previously, the need for rigorous meta-analyses of the therapeutic use of meditation practices has been recognized by other researchers.[3,369] To our knowledge, there has been no other meta-analysis of the effectiveness of meditation practices that covers the range of meditation techniques examined here or the breadth of health outcomes. In addition, the relatively large number of included studies reported in dissertations (10 percent of all studies) may have reduced the potential effects of publication bias (i.e., the tendency for studies with positive outcomes to be published more frequently). We were also able to identify and exclude from the review a significant number of multiple publications that may have also affected the results of our meta-analyses and their conclusions.

The assessment of the methodological quality for all study designs is also a strength of this review. Methodological quality may be defined in various ways.[372] Our approach to the methodological quality of the studies on meditation practices focused on an assessment of the internal validity of the studies, as recommended by several researchers.[42,373-375] Various criteria to assess methodological quality of studies are available in the scientific literature,[376] and there is no consensus on which quality assessment tool can be recommended without reservation.[50] For the assessment of the methodological quality of RCTs, we have chosen two assessment tools that have well-established face validity, and for which a relationship with bias has been proven in empirical studies.[40,350] The selection of the Jadad scale has relative merit since it uses a simple and easy to understand approach that incorporates the most important individual components of internal validity: randomization, blinding, and handling of patient attrition. Based on empirical evidence and theoretical considerations, these aspects should always be assessed when evaluating the quality of an RCT.[350]

The most important dimension of methodological quality is internal validity, defined as the confidence that the design, performance, and report of a trial prevent or reduce bias in the outcomes.[372] We have not addressed in our approach other important aspects of good research practice—those contributing to studies' external validity and adherence to ethical procedures. Although such factors are important and help to put study findings in context, they may not be directly related to internal validity, but may contribute indirectly to it. It is unknown how factors related with external validity may bias study results, and, therefore, research syntheses' findings. Certainly, the external validity of a trial is a very important concept that it is worthy of consideration in future reviews; however, it was not covered in our methodological assessment.

We have adopted a model for quality assessment of research on meditation based on stringent criteria of research methodology. Evaluation of CAM treatments, including meditation, requires a stringent and systematic approach.[352,377] The Jadad scale is the most commonly used quality scale for RCTs in pharmacological and nonpharmacological reviews.[378] The decision to use both the Jadad scale and the concealment of allocation approach reflects our emphasis on using the same methodological standards to assess the quality of research in meditation as applied to other areas of CAM research.

We did not make any decisions in terms of inclusion or exclusion of studies in the review or in the meta-analyses based on the overall Jadad score. We also analyzed the methodological quality of the RCTs by the individual components of the scale (i.e., percentage of studies that satisfied the Jadad criteria).

Though no reliable and valid instruments have been developed for the assessment of observational studies and before-and-after studies, the instruments used here serve to indicate important potential methodological weaknesses, tempering the conclusions that may be drawn, and highlighting areas in which future research might improve.

Despite its strength, the use of nonstandardized quality assessment instruments may be questioned. However, the assessment criteria were not used to produce an overall quality score or to exclude studies from the review, but only to draw out commonalities in potential methodological problems. Because of the potential methodological weaknesses of the studies and the use of weak study designs, the question of how meditation achieves its effects remains almost as open to debate as it did over 25 years ago.[379]

It is unlikely that all of the meditation research meeting our inclusion criteria has been identified and acquired. In particular, a number of Indian journals have not been indexed and are difficult to acquire, particularly Yoga specialty journals. We did not contact either any religious/spiritual organization to acquire information regarding unpublished studies. Nevertheless, it is likely that the vast majority of publications that satisfy our inclusion criteria have been examined and that the general trends reported in this review are sufficiently representative of the research on meditation practices.[337]

Peer reviewers have provided references to potentially relevant studies that were not identified during the development of this report. To increase the transparency of this report, we have collated the references of these studies following the “References and Included Studies” section. Despite the comprehensiveness of our search strategies for the literature search, there are inevitable gaps in literature retrieval, especially with respect to gray literature when conducting systematic reviews. The impact of the potentially relevant studies identified by the peer reviewers should be weighed against the number of studies that were actually retrieved and included.

The restriction of included studies to English-language publications is of special concern in this topic because of the origin of many of these techniques in non-English speaking countries. In light of a recent bibliometric study on Yoga that reported that there is a large amount of research by Indian researchers,[337]it is possible that there is a substantial evidence base on Yoga that remains untapped. In addition, it is likely that a significant amount of the research on Tai Chi[29] and Qi Gong has been published in the Chinese language. However, despite this potential weakness, some research has shown that compared to language inclusive meta-analyses, language restricted meta-analyses did not differ with respect to the estimate of benefit of the effectiveness of an intervention, and there is no evidence that language restricted meta-analyses lead to biased estimates of intervention effectiveness.[380]

This review may be also be criticized for ignoring important differences between meditation practices and techniques by using categories for studies using “single entity” practices, e.g., TM®, RR, and CSM, and for those practices that are made up of a broad array of techniques, e.g., Yoga, Tai Chi, and Qi Gong. Thus while the meta-analytic techniques used here may be appropriate for standardized “single entity” practices, such an approach, when used to combine complex interventions, may produce spurious or misleading results. For example, one of the problems of combining the results of studies that use different yogic techniques is that “fine grained” descriptions of many of these techniques are not reported. This lack of reporting increases the possibility of pooling the results for yogic practices that were putatively designed to have different effects.

To address this potential problem, we have used measures of heterogeneity to help identify those groups of studies that may differ in important clinical characteristics as well as examining the descriptions of the techniques employed in the studies. The combining of results was based on these “fine grained” descriptions; however, poor reporting of meditation practices employed in studies leaves open the possibility that such combinations may have occurred. In addition, caution should be taken in concluding that the effects of complex or composite interventions are due to the practice of meditation rather than to other main components of the treatment such as physical exercise.

The approach adopted here of combining the results of only two studies may be considered inappropriate by some researchers because it is unlikely that only two studies provide strong evidence with respect to the general direction or effect size of the intervention. Also, if the results of two studies differ in direction of effect, at least one more study is needed to help strengthen the evidence regarding the true direction of the effect. However, it must be remembered that one of the principal reasons for conducting a meta-analysis is not only for summarizing the discrepant results of a large number of studies but also for overcoming the imprecision resulting from small sample sizes. By combining several studies with small samples, the overall estimate provides a more precise estimate of effect than either of the studies on their own. Thus, combining only two studies can provide an informative picture of the likely effect of an intervention.

Finally, a main weakness of this report is the lack of assessment of the appropriateness of controls. The need for appropriate controls, described by some researchers as the most difficult conundrum for designing research trials in meditation,[381] is closely related to the difficulties in designing rigorous double-blind meditation trials. Though some controls may be adequate to compare the relative effectiveness of two different interventions (e.g., rest meditation versus quiet rest), such controls may not be adequate placebo controls needed to assess the effects of meditation interventions.[381] Though we are unaware of assessment tools developed to specifically address this issue as it pertains to meditation practices, the comprehensive categorization given in this report of the kinds of controls used in meditation research provides future researchers with a starting point for examining the appropriateness of controls for various therapeutic meditation practices.

Future Research

Future research in practices of meditation has several challenges. First, there is a need to develop a consensus on a working definition of meditation applicable to a heterogeneous group of practices. The application of consensus techniques, such as the Delphi method used in this report, is one approach to refine operational criteria and to standardize terms with the goal of achieving consistency among the characterizations of meditation practices. The validity and reliability of any operational definition applied to diverse meditation practices should be thoroughly investigated. Another area of future inquiry consists of systematically comparing the effects of different meditation practices that research shows have promise.

We have assessed the quality of meditation research from studies that have been published between 1956 and 2005. Half of them have been published after 1994. We did not set any restrictions in terms of the year of publication of the included studies, and it is possible that the standard for a rigorous study in the earlier years of research might be different before 1994 than that of the past 15 years. Future reviews should examine how the quality of studies on meditation practices has evolved over time and particularly whether guidelines such as CONSORT have improved the reporting of RCTs.

We have analyzed the evidence of the therapeutic effects of meditation practices for the three most studied conditions identified in the scientific literature. Evidence of the effects of meditation practices for other conditions frequently reported in the scientific literature (i.e., a variety of mental health problems such as anxiety disorders and depression, and musculoskeletal conditions such as fibromyalgia and chronic pain)) should be evaluated in systematic reviews in the near future. Further reviews should address the effects of meditation practices as strategies to enhance wellness and well-being in healthy population.

In light of the few intervention studies that provided direct comparisons of meditation practices or that used similar control groups, special attention should be paid to developing studies that provide a more accurate assessment of the efficacy and effectiveness of meditation practices, both against standard therapies and against each other. The appropriate selection of controls is also paramount if progress is to be made with respect to determining the effects of meditation practices. Future research should be directed toward investigating the unique challenges that the studies on meditation practices present in designing appropriate controls. In addition, more research should be done on the "dose response" of meditation practices to determine what may be effective study durations and to help standardize courses of therapeutic meditation.

As noted earlier, blinded allocation to meditation treatments may be difficult, but it is not impossible. There are many ways in which to circumvent the difficulties in blinding the experimenter many of which rely on "creative" (i.e., nonstandard methods). These suggestions follow other proposed modifications of the traditional double-blind methodology such as the "dual-blinding" approach (a methodology where the subject and an external evaluator, but not the practitioner, are blind to treatment) [382] Given the strength of the RCTdesign in providing estimates of effectiveness, it appears important to develop research in this domain instead of trying to change the instruments with which the quality of research is assessed.

NCCAM is striving to elevate CAM research to a higher standard, and we think that creative solutions to the difficulties of conducting randomized, double-blind controlled trials should be applied to meditation research.

Key methodological issues in the study of meditation using an evidence-based approach should be further explored through the analysis of important factors such as the impact of publication bias in meditation research (e.g., positive outcome bias, time to publication bias, empirical evidence of relationships between study quality and effect estimates in meditation research, the impact of language bias in systematic reviews of meditation practices, the impact of year of publication of primary studies on pooled estimates in meditation research, trends of quality of primary studies and systematic reviews in meditation, and use of quality assessment tools in meditation research). The effect of report of funding and disclosure of conflict of interest and positive outcomes also merits formal evaluation.

Because of the difficulty of determining causation using uncontrolled before-and-after designs, it is recommended that these study designs be avoided in future research on the effectiveness of meditation practices . Researchers should aim to employ designs and analytic strategies that optimize the ability to make causal inferences (in some cases this may require the use of uncontrolled before-and-after designs). Although it is important to suggest conducting more high quality studies based on the standards for RCTs, it is also important to develop alternative study designs and analytic tools that can incorporate the special features of meditation practices to fully investigate the possible effects of these practices. As well, future studies would benefit from having larger samples with concurrent controlled designs, using disease-specific measures and providing clearer descriptions of intervention components. The quality of reporting of meditation research would be improved by a wider dissemination and stricter enforcement of the CONSORT guidelines within the CAM community.

Conclusions

The field of research on meditation techniques and their therapeutic applications has been clouded by confusion over what constitutes meditation and by a lack of methodological rigor in much of the research. Further research needs to be directed toward distinguishing the effects and characteristics of the many different techniques falling under the rubric "meditation." The single and multimodality meditation practices included in this report were categorized for pragmatic reasons, but specific attention must be paid to developing definitions for these techniques that are both conceptually and operationally useful. Such definitions are a prerequisite for scientific research of the highest quality. Research of higher quality is vital to respond appropriately to the many persistent questions in this area. The dearth of high-quality evidence highlights the need for greater care in defining and choosing the interventions and in choosing controls, populations, and outcomes that permit comparison of studies across techniques regarding their therapeutic effects. More care in these choices will allow effects to be estimated with greater reliability and validity. More randomized trials that draw on the experience of investigators or consultants with a strong background in clinical and basic research should be conducted. As a whole, firm conclusions on the effects of meditation practices in healthcare cannot be drawn based on the available evidence. However, the results analyzed from methodologically stronger research include findings sufficiently favorable to emphasize the value of further research in this field. It is imperative that future studies on meditation practices be more rigorous in design, execution, and analysis, and in the reporting of the results. Greater importance should be placed on the reporting of study methods and providing detailed descriptions of the training of the participants, qualifications of meditation instructors, and on reporting the criteria and methods used to determine a successful meditation practice.

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1029. Heaton DP, Orme-Johnson DW. The Transcendental Meditation program and academic achievement. In: Orme-Johnson DW, Farrow JT, eds. Scientific research on the Transcendental Meditation program: collected papers. Vol. 1. Switzerland: Maharishi European Research University - MVU Press; 1977. p. 396-9.

1030. Aron A, Orme-Johnson DW, Brubaker P. The Transcendental Meditation program in the college curriculum: a 4-year longitudinal study on effects on cognitive and affective functioning. In: Chalmers RA, Clements G, Schenkluhn H, et al., eds. Scientific research on Maharishi's Transcendental Meditation and TM-Sidhi programme: collected papers. Vol. 3. Switzerland: Maharishi European Research University - MVU Press; 1990. p. 1977-82.

1031. Eppley KR, Abrams AI, Shear J. Differential effects of relaxation techniques on trait anxiety: a meta-analysis. J Clin Psychol 1989;45(6):957-74.

List of Studies Potentially Relevant to the Review

The following studies were not retrieved through the formal literature search and were identified by peer reviewers as potentially relevant to this review. (n = 17).
More detailed examination of these studies is required to determine which, if any, of the research topics they may help to address.

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Backon J, Matamoros, Ramirez M, et al. A functional vagotomy induced by unilateral forced right nostril breathing decreases intraocular pressure in open and closed angle glaucoma. Br J Ophthalmol 1990; 74:607-9.

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Cranson R. Increased general intelligence through the Transcendental Meditation and TM-Sidhi program. In: Wallace RK, Orme-Johnson DW, Dillbeck MC, eds. Scientific research on Maharishi's Transcendental Meditation and TM-Sidhi program : collected papers. Vol. 5. Fairfield, IA: Maharishi International University Press; 1990. p.3078.

Fergusson LF, Bonshek AJ, Le Masson, G. Vedic Science based education and nonverbal intelligence: a preliminary longitudinal study in Cambodia. Higher Education Research and Development 1995;15: 73-82.

Garnier D, Cazabat A, Thebault P; et al. An experimental study: pulmonary ventilation during the Transcendental Meditation technique—applications in preventive medicine. Est-Médicine 1984;4(76): 867–70.

Gelderloos P. Psychological health and development of students at Maharishi International University: a controlled longitudinal study. In: Wallace RK, Orme-Johnson DW, Dillbeck MC, eds. Scientific research on Maharishi's Transcendental Meditation and TM-Sidhi Program : collected papers. Vol. 5. Fairfield, IA: Maharishi International University Press; 1990. p.3097-3106.

Haratani T, Hemmi T. Effects of Transcendental Meditation on the mental health of industrial workers. Japanese Journal of Industrial Health 1990;32(7): 656.

Hill DA, Wallace RD, Walton KG, Meyerson LR. Acute decreased platelet serotonin and attenuation of autonomic activity in the Transcendental Meditation program (TM) [abstract]. Soc Neurosci 1989;15:1281.

Jevning R, Wilson AF, Pirkle H, et al. Modulation of red cell metabolism by states of decreased activation: comparison between states. In: Wallace RK, Orme-Johnson DW, Dillbeck MC, eds. Scientific research on Maharishi's Transcendental Meditation and TM-Sidhi Program : collected papers. Vol. 5. Fairfield, IA: Maharishi International University Press; 1990. p.2988-92.

Jevning R, Wells I, Wilson AF, Guich S. Plasma thyroid hormones, thyroid stimulating hormone, and insulin during acute hypometabolic states in man. In: Wallace RK, Orme-Johnson DW, Dillbeck MC, eds. Scientific research on Maharishi's Transcendental Meditation and TM-Sidhi program : collected papers. Vol. 5. Fairfield, IA: Maharishi International University Press; 1990. p.2999-3002.

Luparello TJ, Leist N, Lourie CH, Sweet P. The interaction of psychologic stimuli and pharmacologic agents on airway reactivity in asthmatic subjects. Psychosom Med 1970;32(5):509-13.

MacLean C, Schneider R, Wenneberg S, Levitsky D, Walton K.. Reactivity of plasma serotonin to psychological stress. Trans Amer Soc Neurochem 1992;23:223.

Schneider RH, Mills PJ, Schramm W, et al. Luteinizing hormone: a marker for type A behavior and its modification by the Transcendental Meditation program? In: Wallace RK, Orme-Johnson DW, Dillbeck MC, eds. Scientific research on Maharishi's Transcendental Meditation and TM-Sidhi Program : collected papers. Vol. 5. Fairfield, IA: Maharishi International University Press; 1990. p. 3011.

Tjoa A. Some evidence that the Transcendental Meditation program increases intelligence and reduces neuroticism as measured by psychological tests. In: Orme-Johnson DW, Farrow JT, eds. Scientific Research on Maharishi's Transcendental Meditation and TM-Sidhi program: collected papers. Vol.1. Switzerland: Maharishi European Research University – MVU Press; 1977. p.363-7.

Travis F. Development along an integration scale: longitudinal transformation in brain dynamics with regular Transcendental Meditation practice. Psychophysiology 2002;39: S81

Walton KG, Gelderloos P, Pugh NDC, Macrae P, Goddard P, MacLean C, Levitsky D. Stress as the cause of serotonergic dysfunction in mental disorders: support from correlates of serotonin turnover in normal subjects [abstract]. Soc. Neurosci. 1989;15:1282.

Abbreviations

Abbreviation	Description
AA	Alcoholics Anonymous
ACF	adrenocortical functioning
Ach	acetylcholine
AEI	artery elasticity index
AHM	antihypertensive medication
AHRQ	Agency for Healthcare Research and Quality
AI	alpha index
AMI	acute myocardial infarction
APO-A1	apolipoprotein A1
AT	autogenic training
ATN	attention
BC	blood composition
BDT	bone density test
BE	breathing exercises
BF	biofeedback
BGM	blood gass measurement
BHT	borderline hypertension
BHt	breath holding time
BL	blood lactate
BM	blood measurement
BMI	body mass index
BNP	B-type natriuretic peptide
BP	blood pressure
BR	breathing rate
bpm	beats per minute
BS	blood sugar
Ca	calcium
CABS	coronary artery bypass surgery
cAMP	cyclic adenosine monophosphate
CF	cognitive function
CHD	chronic heart disease
ChE	cholinesterase
cIMT	carotid intima media thickness
CM	carbohydrate metabolism
CMBT	contemplative meditation with breathing techniques
CNS-H	central nervous system hormone
CO	cardiac output
COG/N	cognitive/neuropsychological
COPD	chronic obstructive pulmonary disease
CPR	cold pressor response
Cr	creatinine

CRT	cognitive restructuring training
CSM	Clinically Standardized Meditation
CTY	creativity
CV	cardiovascular
CVF	cardiovascular functioning
d	day(s)
DBH	dopamine beta hydroxylase
DBP	diastolic blood pressure
DHEAS	dehydroepiandrosterone
DIG	digestive
DM	diabetes mellitus
DPV	digital pulse volume
E/A ratio	early filling divided by atrial constriction
ECG	electrocardiography
EEG	electroencephalogram
EMG	electromyography
EPC	Evidence-based Practice Center
EPI	epinephrine
ESR	erythrocyte sedimentation rate
FBS	fasting blood sugar
FEV1	forced expiratory volume in one second
FPA	finger plethysmogram amplitude
FVC	forced vital capacity
GH	growth hormone
Glc	glucose
GLH	glycosylated hemoglobine
GSH	glutathione
GSR	galvanic skin response
Hb	hemoglobin
Hb-A1c	hemoglobin A1c
HDL-C	high-density lipoprotein cholesterol
HE	health education
HI	humoral immunity
HIV	human immunodeficiency virus
HR	heart rate
HRQL	health-related quality of life
HRV	heart rate variability
HT	hypertension
HVA	homovanillic acid
IQR	interquartile range
ITT	intention-to-treat
IVST	intraventricular septal thickness
JNC 7	Joint National Committee 7
K	potassium
LDL-C	low-density lipoprotein cholesterol
LDH	lactate dehydrogenase

LFPMF	low frequency pulsed magnetic field
LIP	lipoproteins
LLM	lowering lipid medication
LSD	lysergic acid diethylamide
Lt	left
LVDIS	left ventricular internal dimension at systole
LVDDi	left ventricular end diastolic volume index
LVEF	left ventricular ejection fraction
LVIDD	left ventricular internal dimension at diastole
LVMI	left ventricular mass index
MBCT	mindfulness-based cognitive therapy
MBSR	mindfulness-based stress reduction
MEM	memory
MEP	maximum expiratory volume
Mg	magnesium
MHPG	3-methoxy-4-hydroxyphenylglycol
MI	myocardial infarction
MIP	maximum inspiratory pressure
MM	mindfulness meditation
mo.	month(s)
MSK	musculoskeletal
MVV	maximal voluntary ventilation
Na	sodium
NA	not applicable
NCCAM	National Center for Complementary and Alternative Medicine
ND	not described
NE	norepinephrine
NER	nervous
NHS	National Health System
NIDDM	noninsulin dependent diabetes mellitus
N/M	nutrition/metabolism
NOS	Newcastle-Ottawa Scales
NR	not reported
NRCT	nonrandomized controlled clinical trial
NS	not specified
NT	no treatment
NYHA	New York Heart Association
OGTT	oral glucose tolerance test
OH-DOC	hydroxydeoxycorticosterone
OR	odds ratio
PAA	peak aortic acceleration
PaO_2	pressure of oxygen
PBI	protein bound iodine
PEF (25-75)	peak expiratory flow at piddle portion of expiration
PEFR	peak expiratory flow rate
PER	perception

PFT	pulmonary function test
PIFR	peak inspiratory flow rate
PLB	placebo
P-MDA	plasma malondialdehyde
PMR	progressive muscle relaxation
PO_2	pressure of oxygen
PP	pulse pressure
PPT	physical performance test
PRA	plasma renin activity
PR	pulse rate
PWT	posterior wall thickness
RA	renin activity
RCT	randomized controlled clinical trial
RER	respiratory exchange ratio
RES	respiratory
Res-v	respiratory variability
RFT	renal function test
RPP	rate pressure product
RR	relaxation Response
RSG	reasoning
RT	reaction time
Rt	right
SA	spatial ability
SAO_2	saturated oxygen
SBP	systolic blood pressure
S-Ca	serum calcium
SCL	skin conductance level
SD	standard deviation
se	session
SEN	sensory
SI	serum insulin
SMD	standardized mean difference
S-Mg	serum magnesium
SMF	sensory motor function
SPSS	Statistical Package for the Social Sciences
SRL	skin resistance level
SRS	Systematic Review Software
SVR	systemic vascular resistance
TC	total cholesterol
TEE	total energy expenditure
TG	triglycerides
TEP	technical expert panel
THR	thermoregulatory
TM®	Transcendental Meditation®
TOO	Task Order Officer
TSH	thyroid stimulating hormone

TV	tidal volume
UAEPC	University of Alberta Evidence-based Practice Center
UC	usual care
UE	urinary/excretory
UFNB	unilateral forced nostril breathing
UL	urine lactate
ULNB	unilateral left nostril breathing
UNB	unilateral nostril breathing
URNB	unilateral right nostril breathing
VA	verbal ability
VCO_2	carbon dioxide production
Ve	minute ventilation
VE/VCO_2	rate of increase of ventilation per unit of increase of carbon dioxide production
VLDL-C	very low density lipoprotein cholesterol
VMA	vanillylmandelic acid
VO_2	oxygen consumption
VO_2 max	maximum oxygen consumption
WBC	white blood cell
wk	week(s)
WL	waiting list
WR	work rate
WMD	weighted mean difference
yr	year(s)
Zn	zinc
5-HIAA	5-hydroxyindole acetic acid
17-KS	17-ketosteroids
95% CI	95% confidence interval

Appendix A. Technical Experts and Peer Reviewers

Technical Expert Panel

In designing the study questions and methodology at the outset of this report, the EPC consulted several technical and content experts. Broad expertise and perspectives are sought. Divergent and conflicted opinions are common and perceived as health scientific discourse that results in a thoughtful, relevant systematic review. Therefore, in the end, study questions, design and/or methodologic approaches do not necessarily represent the views of individual technical and content experts.

Name	Institution
John Astin, Ph.D.	California Pacific Medical Center, San Francisco, CA, United States
Ruth Baer, Ph.D.	University of Kentucky, Lexington, KT, United States
Vernon Barnes, Ph.D.	Medical College of Georgia, Augusta, GA, United States
Linda Carlson, Ph.D, C.Psych.	University of Calgary, Calgary, AB, Canada
Jeffery Dusek, Ph.D.	Harvard Medical School, Boston, MA, United States
Thierry Lacaze-Masmonteil, M.D., Ph.D., F.R.C.P.C.	University of Alberta, Edmonton, AB, Canada
Badri Rickhi, M.D., Ph.D.	Canadian Institute of Natural and Integrative Medicine (CINIM), Calgary, AB, Canada
David Shannahoff-Khalsa, B.A.	University of California at San Diego, San Diego, CA, United States

Peer Reviewers

Peer reviewer comments on a preliminary draft of this report were considered by the EPC in preparation of this final report. Synthesis of the scientific literature presented here does not necessarily represent the views of individual reviewers.

Name	Institution
Kirk Warren Brown, Ph.D.	Virginia Commonwealth University, Richmond, VA, United States
Bei-Hung Chang, Sc.D.	Boston University School of Public Health, Boston, MA, United States
Thawatchai Krisanaprakornkit, M.D.	Khon Kaen University, Khon Kaen, Thailand
T. M. Srinivasan, Ph.D.	The International Society for the Study of Subtle Energies and Energy Medicine, Madras (Chennai), India
Harald Walach, Ph.D.	The University of Northampton, Northampton, United Kingdom
Ken Walton, Ph.D.	Maharishi University of Management, Fairfield, IA, United States
Gloria Yeh, M.D., M.P.H.	Osher Institute at Harvard Medical School, Boston, MA, United States

Appendix B. Development of Consensus on a Set of Criteria for an Operational Definition of Meditation

A consensus definition of meditation has not been established. The rationale for developing a consensus definition for meditation was to guide an unbiased selection of studies to be included in the review. We sought to develop consensus among a panel of experts on a set of criteria for a working definition of meditation; the relative importance of these criteria in defining a practice as meditation; and on a classification of practices as meditation or not meditation.

Methods

Study Design

A five-round modified Delphi study was conducted from August to December 2006. The Delphi technique is a research tool designed to address complex problems with a high level of uncertainty that are not suited to statistical methods or open deliberation.[36,37] Its goal is to obtain the most reliable consensus among a group of experts on a particular topic.[36] The technique involves recruiting a group of experts to participate in an iterative process of answering questionnaire, receiving feedback regarding group responses, and revising their opinions in light of this feedback.[37] The distinguishing characteristics of the Delphi technique are anonymity, iteration (processes occur in rounds), controlled feedback, (showing the distribution of the group's response) and statistical group response (expressing judgment using summary measures of the full group response). This method was chosen over other consensus techniques due to its ability to allow all group members equal participation and influence, even when separated geographically.[383]

Study Participants

Participants were seven individuals who acted as members of the Technical Expert Panel (TEP) for a report on the state of the research of meditation practices in healthcare. Each member lived in the United States or Canada and had expertise and training in meditation practices.

Development of Questionnaires

An initial list of potential criteria for an operational definition of meditation was generated from a preliminary list of key articles.[9,98] Similarly, a list of potential meditation practices was developed based on an initial review of the literature.. The items were refined through an iterative review process, until a set of nine criteria to define meditation was found. The first-round questionnaire consisted of two parts. In the first part of the survey, participants were asked to rate the importance of the nine criteria as "not important at all," "important but not essential," or "essential. They were also asked to suggest any other criteria that they felt were essential for a working definition of meditation. In the second part of the questionnaire, participants were given a list of 41 interventions and were asked to indicate which interventions qualified as meditation practices based on the essential criteria rated in the first part of the questionnaire. The participants were also asked to indicate any other intervention that they believed involved meditation but that was not represented in the list.

In round two, feedback was provided on the group responses from round one. The participants were asked to reflect on their responses from the first round in light of the peer responses and to either confirm or change their responses accordingly. Based on round one comments, the wording of some criteria was modified, and three practices were added to the list of interventions. The second-round process was repeated until consensus was reached in round five. Round three helped to establish consensus on items for which disagreement persisted. Round four aimed to determine if the criteria considered “essential” to meditation in previous rounds were, in fact, a necessary part of the practices. Participants were asked to indicate which of the “essential” and “important but not essential” criteria applied to each potential intervention. The list of potential meditation practices was refined until consensus was reached.

Study Procedures

The TEP members received a personalized letter describing the Delphi process, and the expectations regarding their participation. The questionnaires were sent electronically. Participants were given up to 1 week to respond to each questionnaire, and nonresponders were sent one reminder. Although participants were aware of the identity of other responders, they were blind to individual responses, ensuring anonymity throughout the process.

Data Analysis

Data from electronic questionnaires were exported into Microsoft Excel™ (Microsoft Corporation, Redmond, WA) spreadsheets and analyzed with Statistical Package for the Social Sciences for Windows (SPSS™ version 14.1, SPSS, Inc., Chicago, IL). Categorical data were collected from each survey round and expressed as frequencies. The frequency of endorsement was tabulated for each criteria and practice. A priori, it was established that a frequency of endorsement of five out of seven would be considered consensus.

Results

The response rate in all rounds of the survey was 100 percent. Table B1 shows the experts’ final-round responses regarding the importance of various criteria for a working definition of meditation. Participants in the Delphi study agreed that a meditation practice (1) uses a defined technique, (2) involves logic relaxation, and (3) involves a self-induced state/mode. These criteria were considered essential. Participants also agreed that a meditation practice may (1) involve a state of psychophysical relaxation somewhere in the process; (2) use a self-focus skill or anchor; (3) involve an altered state/mode of consciousness, mystic experience, enlightenment or suspension of logical thought processes; (4) be embedded in a religious/spiritual/philosophical context; or (5) involve an experience of mental silence. After round four, participants did not reach consensus on whether bringing about mental calmness and physical relaxation by suspending the stream of thoughts would be essential or important to define an intervention as meditation.

Table B1. Final responses for the importance of various criteria for an operational definition of meditation

Criteria	Not important at all	Important but not essential	Essential	Don't know
1. It uses a defined technique	0	0	**7**	0
2. It involves logic relaxation: not "to intend" to analyze the possible psychophysical effects, not "to intend" to judge the possible results, not "to intend" to create any type of expectation regarding the process	0	0	**7**	0
3. It involves a state of psychophysical relaxation installed somewhere during the process	1	**5**	1	0
4. It involves a self-induced state/mode. It refers to a therapeutic method that can be taught by an instructor, but self-applied by the individual him/herself. It must, for instance, be feasible to be done at home, without the presence of the instructor. There must not be any relationship of dependence	0	1	**6**	0
5. It uses a self-focus skill or "anchor. A concentration ("positive anchor") or a turning off ("negative anchor") focus is used, in order to avoid sequels of undesirable thinking, torpor, sleep	0	**5**	2	0
6. It involves altered states/modes of consciousness, mystic experiences, "enlightenment" or suspension of logical thought processes	1	**5**	1	0
7. It is embedded in a religious/ spiritual/philosophical context	0	**7**	0	0
8. It involves an experience of mental silence	0	**5**	1	1
9. It involves a self-paced systematic desensitization	**6**	1	0	0
10. It brings about mental calmness and physical relaxation by suspending the stream of thoughts that normally occupy the mind	0	3	4	0

Table B2 shows the experts' final responses regarding the interventions that can be considered as meditation practices or practices involving a meditative component. The experts agreed that 32 out of 41 potential interventions were meditation or involved a meditative component in the practice; therefore, these 32 practices were considered for inclusion in the review.

Table B2. Final responses for interventions considered meditation practices or practices involving a meditative component

Intervention	Yes	No	Don't know
1. Vipassana	**7**	0	0
2. Dhyana	**7**	0	0
3. Zen Budhhist meditation (Zazen)	**7**	0	0
4. Kinemantra meditation (KM)	**7**	0	0
5. Anapana sati	**6**	1	0
6. Mindfulness-based stress reduction (MBSR)	**7**	0	0
7. Mindfulness-based cognitive therapy (MBCT)	**7**	0	0
8. Transcendental Meditation® technique (TM®)	**7**	0	0
9. Mindfulness meditation (MM)	**7**	0	0
10. Relaxation response (RR)	**7**	0	0
11. Progressive muscle relaxation (PMR)	0	**7**	0

Table B2. Final responses for interventions considered as meditation practices or practices involving a meditative component (continued)

Intervention	Yes	No	Do not know
12. Unilateral forced nostril breathing	**6**	1	0
13. Yoga (any)	**6**	1	0
14. Kundalini yoga	**7**	0	0
15. Raja yoga	**7**	0	0
16. Hatha yoga	**5**	2	0
17. Sudarshan kriya yoga	**6**	1	0
18. Yogic breathing	**6**	1	0
19. Pranayama	**6**	1	0
20. Kapalabhati	**6**	1	0
21. Centering prayer	**6**	1	0
22. Qigong	**5**	1	1
23. Tai chi	**5**	2	0
24. Samadhi	**7**	0	0
25. Visual imagery	0	**7**	0
26. Guided imagery	1	**5**	1
27. Guided visualization	1	**6**	0
28. Creative visualization	1	**6**	0
29. Mantra	**7**	0	0
30. Pratyahara	**6**	1	0
31. Dharana	**7**	0	0
32. Tae eul ju	**5**	1	1
33. Hesychasm	**5**	2	0
34. Lectio divina	2	**5**	0
35. Silva method	1	**6**	0
36. Naam	**5**	2	0
37. Dialectical behavior therapy	1	**6**	0
38. Autogenic training	0	**7**	0
39. Clinically standardized meditation	**5**	2	0
40. Sound chanting	**5**	2	0
41. Sufic practices	**7**	0	0

This study was undertaken to develop a working definition of meditation that could be used to clearly differentiate meditation practices from those that are not meditation. These criteria formed part of a multicomponent approach to study selection in the report on the state of research of meditation practices for healthcare. The results of this study provide valuable insight into the problem of defining meditation and pcontribute with a preliminary set of criteria with which to judge potential meditation practices.

Appendix C. Exact Search Strings

Table C1. MEDLINE®—Ovid version

Years/issue searched: 1966 to August 2005, week 5
Search date: September 8, 2005

1. exp meditation/
2. exp yoga/
3. meditat$.mp.
4. cogitat$.ti,ab.
5. Pranayam$.mp.
6. kapalabhati.ti,ab.
7. (yoga or yogic$).mp.
8. mindful$.mp.
9. zen.ti,ab,sh.
10. transcendental.ti,ab.
11. TM-Sidhi.mp.
12. mahayana.ti,ab.
13. hiniyana.ti,ab.
14. theravada$.ti,ab.
15. vajrayana.ti,ab.
16. (vipissana or vipashyana).ti,ab.
17. (dhyana or dyana).ti,ab.
18. dharana.ti,ab.
19. zazen.ti,ab.
20. (kinemantra or KM).ti,ab.
21. (mantra or mantras).mp.
22. (samadhi or samatha).ti,ab.
23. pratyahara.ti,ab.
24. purusha.ti,ab.
25. prakruti.ti,ab.
26. ((Visual or guided) adj5 imagery).mp.
27. ((guided or creative or vivid) adj visualization).ti,ab.
28. pray$.mp.
29. Hesychasm.ti,ab.
30. "lectio divina".ti,ab.
31. bonadona.ti,ab.
32. (qigong or qi gong).mp.
33. ch'i kung.ti,ab.
34. "Tae Eul Ju".ti,ab.
35. "mind-body and relaxation techniques"/ or "mind-body relations (metaphysics)"/
36. tai ji/
37. (tai chi or tai ji).mp.
38. Taijiquan.ti,ab.
39. "open awareness".mp.
40. "focused awareness".mp.
41. "relaxation response".mp.
42. "progressive muscle relaxation".ti,ab.
43. progressive relaxation.ti,ab.
44. "forced nostril breathing".ti,ab.
45. "Uninostril breathing".ti,ab.
46. "unilateral breathing".ti,ab.
47. (Khundalini or Kundalini).mp.
48. raja.ti,ab.
49. hatha.ti,ab.
50. "sudarshan kriya".ti,ab.
51. RRMM.ti,ab.
52. MBSR.ti,ab.
53. MBCT.ti,ab.
54. "Wide-angle lens attention".ti,ab.
55. ("Anapana Sati" or anapanasati).mp.
56. kabat-zinn.ab.
57. or/1-56
58. RANDOMIZED CONTROLLED TRIAL.pt.
59. CONTROLLED CLINICAL TRIAL.pt.
60. RANDOMIZED CONTROLLED TRIALS
61. RANDOM ALLOCATION/
62. DOUBLE BLIND METHOD/
63. SINGLE-BLIND METHOD/
64. or/58-63
65. ANIMAL/ not HUMAN/
66. 64 not 65
67. CLINICAL TRIAL.pt.
68. exp CLINICAL TRIALS/
69. (clin$ adj25 (trial$ or study or studies or design)).ti,ab.
70. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).ti,ab.
71. PLACEBOS/
72. placebo$.ti,ab.
73. random$.ti,ab.
74. RESEARCH DESIGN/
75. or/67-74
76. 75 not 65
77. 76 not 66
78. COMPARATIVE STUDY/
79. exp EVALUATION STUDIES/
80. FOLLOW UP STUDIES/
81. (Follow up adj5 (study or studies or design)).ti,ab.
82. PROSPECTIVE STUDIES/
83. exp COHORT STUDIES/
84. CROSS-SECTIONAL STUDIES/
85. exp CASE-CONTROL STUDIES/
86. Epidemiologic studies/
87. Epidemiological factors/
88. exp Causality/
89. Age factors/
90. Comorbidity/
91. Odds ratio/
92. exp Risk/
93. Probability/
94. ((Allocat$ or control$ or assign$ or treatment or compar$ or interven$ or experiment$) and (group or groups)).mp.
95. (group or groups).ti,ab.
96. (control$ or prospectiv$ or retrospectiv$ or volunteer$ or participant$ or compar$).mp. and (trial$ or study or studies or design).ti,ab,sh.
97. cohort$.ti,ab.
98. case-control$.ti,ab.
99. Cross sectional.ti,ab.

Table C1. MEDLINE®—Ovid version (continued)

100. (observational adj5 (study or studies or design)).ti,ab.
101. Longitudinal.mp.
102. Retrospective.ti,ab.
103. Relative risk.ti,ab.
104. Odds ratio.ti,ab.
105. (case adj (comparison or referent)).ti,ab.
106. (Causation or causal$).ti,ab.
107. (Analytic adj (study or studies)).ti,ab.
108. or/78-107
109. 108 not 65
110. 109 not (66 or 77)
111. 66 or 77 or 109
112. 57 and 111
113. limit 112 to (humans and english language)
114. limit 113 to "all adult (19 plus years)"
115. 113 not 114
116. limit 115 to "all child (0 to 18 years)"
117. 115 not 116
118. 114 or 117
119. remove duplicates from 118
120. systematic review$.mp.
121. systematic literature review$.mp.
122. meta-analysis.sh.
123. (meta-analys?s or metaanalys?s).ti.
124. evidence-based medicine.mp.
125. quantitative review$.ti,ab.
126. quantitative overview$.ti,ab.
127. quantitative synthes?s.ti.
128. quantitative analys?s.ti,ab.
129. (evidence-based adj (guideline$ or recommendation$)).mp.
130. health planning guideline$.mp.
131. cochrane database of systematic reviews.mp.
132. cdsr.mp.
133. acp journal club.mp.
134. (health tech$ assess$ or hta).mp.
135. technolog$ assess$.mp.
136. evidence based nursing.mp.
137. evidence based mental health.mp.
138. clinical evidence.mp.
139. biomedical technology assessment.sh.
140. evidence report$.mp.
141. or/120-140
142. systematic$.mp.
143. critical.mp.
144. (study and selection).ti,ab.
145. ((predetermined or inclusion) and criteri$).mp.
146. exclusion criteri$.mp.
147. main outcome measure$.mp.
148. "standard$ of care".mp.
149. or/142-148
150. (survey$ or overview$ or review or reviews or search$ or handsearch$).mp.
151. (analys?s or critique or appraisal).mp.
152. (reduction and risk and (death or occurrence)).mp.
153. or/150-152
154. (literature or article$ or publication$ or bibliograph$ or published or unpublished or citation$ or database$ or internet or reference$ or textbook$ or trial$).mp.
155. meta-analysis.sh.
156. (medline or medlars or pubmed or embase or index medicus or cochrane or scisearch or web of science or psychinfo or psychlit or cinahl or experta medica or science citation index or sciences citation index or biological abstracts).mp.
157. (clinical and studies).mp.
158. (treatment outcome or combine$ or combining or peto or der simonian or dersimonian or fixed effect$ or pooled or pooling or mantel haenszel).mp.
159. or/154-157
160. 149 and 153 and 159
161. 141 or 160
162. case report.ti,sh.
163. editorial.ti,pt.
164. letter.pt.
165. note.pt.
166. or/162-165
167. 161 not 166
168. 167 and 57
169. 168 not 119
170. meta-analysis.pt.
171. (meta-anal$ or metaanal$).mp.
172. (((quantitativ$ adj3 review$1) or quantitativ$) adj3 overview$).mp.
173. (((systematic adj3 review$1) or systematic) adj3 overview$1).mp.
174. (((methodologic adj3 review$1) or methodologic) adj3 overview$).mp.
175. (integrat$ adj5 research).mp.
176. (quantitativ$ adj3 synthes$).mp.
177. or/170-176
178. review.pt. or (review$ or overview$).mp.
179. (medline or medlars or pubmed or index medicus or embase or cochrane).mp.
180. (scisearch or web of science or psycinfo or psychinfo or cinahl or cinhal).mp.
181. (excerpta medica or psychlit or psyclit or current contents or science citation index or sciences citation index).mp.
182. (hand search$ or manual search$).mp.
183. ((((electronic adj3 database$) or bibliographic) adj3 database$) or periodical index$).mp.
184. (pooling or pooled or mantel haenszel).mp.
185. (peto or der simonian or dersimonian or fixed effect$).mp.
186. ((combine$ or combining) adj5 (data or trial or trials or studies or study or result or results)).mp.
187. or/179-186
188. 178 and 187
189. 177 or 188

Table C1. MEDLINE®—Ovid version (continued)

190. (hta$ or health technology assessment$ or biomedical technology assessment$).mp.
191. technology assessment, biomedical/ or biomedical technology assessment/
192. 190 or 191
193. 189 or 192
194. 119 and 193
195. 57 and 193
196. 119 or 195

Table C2. EMBASE—Ovid version

Years/issue searched: 1988 to 2005, week 36
Search date: September 8, 2005

1. exp meditation/
2. Transcendental meditation/
3. exp yoga/
4. meditat$.mp.
5. cogitat$.ti,ab.
6. Pranayam$.mp.
7. kapalabhati.ti,ab.
8. (yoga or yogic$).mp.
9. mindful$.mp.
10. zen.ti,ab,sh.
11. transcendental.ti,ab.
12. TM-Sidhi.mp.
13. mahayana.ti,ab.
14. hiniyana.ti,ab.
15. theravada$.ti,ab.
16. vajrayana.ti,ab.
17. (vipissana or vipashyana).ti,ab.
18. (dhyana or dyana).ti,ab.
19. dharana.ti,ab.
20. zazen.ti,ab.
21. (kinemantra or KM).ti,ab.
22. (mantra or mantras).mp.
23. (samadhi or samatha).ti,ab.
24. pratyahara.ti,ab.
25. purusha.ti,ab.
26. prakruti.ti,ab.
27. ((Visual or guided) adj5 imagery).mp.
28. ((guided or creative or vivid) adj visualization).ti,ab.
29. pray$.mp.
30. Hesychasm.ti,ab.
31. lectio divina.ti,ab.
32. bonadona.ti,ab.
33. (qigong or qi gong).mp.
34. ch'i kung.ti,ab.
35. "Tae Eul Ju".ti,ab.
36. relaxation training/ and (Psychophysiology/ or Breathing Exercise/)
37. "Mental Concentration"/ and (Breathing Exercise/ or relaxation training/)
38. (mind adj body).ti,ab.
39. brain mind relationship/
40. exp Tai Chi/
41. (tai chi or tai ji).mp.
42. Taijiquan.ti,ab.
43. "open awareness".mp.
44. "focused awareness".mp.
45. "relaxation response".mp.
46. "progressive muscle relaxation".ti,ab.
47. progressive relaxation.ti,ab.
48. "forced nostril breathing".ti,ab.
49. "Uninostril breathing".ti,ab.
50. "unilateral breathing".ti,ab.
51. (Khundalini or Kundalini).mp.
52. raja.ti,ab.
53. hatha.ti,ab.
54. "sudarshan kriya".ti,ab.
55. RRMM.ti,ab.
56. MBSR.ti,ab.
57. MBCT.ti,ab.
58. "zoom lens attention".ti,ab.
59. "Wide-angle lens attention".ti,ab.
60. ("Anapana Sati" or anapanasati).mp.
61. kabat-zinn.ab.
62. or/1-61
63. Randomized Controlled Trial/
64. exp Randomization/
65. Double Blind Procedure/
66. Single Blind Procedure/
67. or/63-66
68. Clinical Trial/
69. (clin$ adj25 (trial$ or study or studies or design)).mp.
70. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).mp.
71. exp Placebo/
72. (placebo$ or random$).mp.
73. exp Methodology/
74. exp Comparative Study/
75. exp Evaluation/
76. exp Follow Up/
77. exp Prospective Study/
78. clinical study/
79. case control study/
80. family study/
81. longitudinal study/
82. retrospective study/
83. cohort analysis/
84. exp Risk/
85. ((allocat$ or compar$ or assign$ or treatment or control$ or interven$ or experiment$) and (group or groups)).mp.
86. (group or groups).ti,ab.
87. ((control$ or prospectiv$ or retrospectiv$ or volunteer$ or participant$ or compar$) and (trial$ or study or studies or design)).ti,ab,sh.
88. cohort$.ti,ab.
89. "case-control".ti,ab.
90. "Cross sectional".ti,ab.
91. (observational adj5 (study or studies or design)).ti,ab.
92. Longitudinal.mp.
93. Retrospective.ti,ab.
94. "Relative risk".ti,ab.
95. "Odds ratio".ti,ab.
96. (Follow up adj5 (study or studies or design)).ti,ab.
97. (case adj (comparison or referent)).ti,ab.
98. (Causation or causal$).ti,ab.
99. (Analytic adj (study or studies)).ti,ab.
100. (epidemiologic$ adj (study or studies)).ti,ab.
101. or/68-99
102. 67 or 101

Table C2. EMBASE—Ovid version (continued)

103. limit 102 to human
104. Nonhuman/
105. 103 not 104
106. 62 and 105
107. limit 106 to english language
108. limit 107 to (adult <18 to 64 years> or aged <65+ years>)
109. 107 not 108
110. limit 109 to (embryo or infant or child or preschool child <1 to 6 years> or school child <7 to 12 years>)
111. 109 not 110
112. 108 or 111
113. remove duplicates from 112
114. systematic review$.mp.
115. systematic literature review$.mp.
116. meta-analysis.sh.
117. (meta-analys?s or metaanalys?s).ti.
118. evidence-based medicine.mp.
119. quantitative review$.ti,ab.
120. quantitative overview$.ti,ab.
121. quantitative synthes?s.ti.
122. quantitative analys?s.ti,ab.
123. (evidence-based adj (guideline$ or recommendation$)).mp.
124. health planning guideline$.mp.
125. cochrane database of systematic reviews.mp.
126. cdsr.mp.
127. acp journal club.mp.
128. (health tech$ assess$ or hta).mp.
129. technolog$ assess$.mp.
130. evidence based nursing.mp.
131. evidence based mental health.mp.
132. clinical evidence.mp.
133. biomedical technology assessment.sh.
134. evidence report$.mp.
135. or/114-134
136. systematic$.mp.
137. critical.mp.
138. (study and selection).ti,ab.
139. ((predetermined or inclusion) and criteri$).mp.
140. exclusion criteri$.mp.
141. main outcome measure$.mp.
142. "standard$ of care".mp.
143. or/136-142
144. (survey$ or overview$ or review or reviews or search$ or handsearch$).mp.
145. (analys?s or critique or appraisal).mp.
146. (reduction and risk and (death or occurrence)).mp.
147. or/144-146
148. (literature or article$ or publication$ or bibliograph$ or published or unpublished or ciation$ or database$ or internet or reference$ or textbook$ or trial$).mp.
149. meta-analysis.sh.
150. (medline or medlars or pubmed or embase or index medicus or cochrane or scisearch or web of science or psychinfo or psychlit or cinahl or experta medica or science citation index or sciences citation index or biological abstracts).mp.
151. (clinical and studies).mp.
152. (treatment outcome or combine$ or combining or peto or der simonian or dersimonian or fixed effect$ or pooled or pooling or mantel haenszel).mp.
153. or/148-151
154. 143 and 147 and 153
155. 135 or 154
156. case report.ti,sh.
157. editorial.ti,pt.
158. letter.pt.
159. note.pt.
160. or/156-159
161. 155 not 160
162. meta-analysis.pt.
163. (meta-anal$ or metaanal$).mp.
164. (((quantitativ$ adj3 review$1) or quantitativ$) adj3 overview$).mp.
165. (((systematic adj3 review$1) or systematic) adj3 overview$1).mp.
166. (((methodologic adj3 review$1) or methodologic) adj3 overview$).mp.
167. (integrat$ adj5 research).mp.
168. (quantitativ$ adj3 synthes$).mp.
169. or/162-168
170. review.pt. or (review$ or overview$).mp.
171. (medline or medlars or pubmed or index medicus or embase or cochrane).mp.
172. (scisearch or web of science or psycinfo or psychinfo or cinahl or cinhal).mp.
173. (excerpta medica or psychlit or psyclit or current contents or science citation index or sciences citation index).mp.
174. (hand search$ or manual search$).mp.
175. ((((electronic adj3 database$) or bibliographic) adj3 database$) or periodical index$).mp.
176. (pooling or pooled or mantel haenszel).mp.
177. (peto or der simonian or dersimonian or fixed effect$).mp.
178. ((combine$ or combining) adj5 (data or trial or trials or studies or study or result or results)).mp.
179. or/171-178
180. 170 and 179
181. 169 or 180
182. (hta$ or health technology assessment$ or biomedical technology assessment$).mp.
183. technology assessment, biomedical/ or biomedical technology asssessment/
184. 182 or 183
185. 181 or 184
186. 161 or 185
187. 186 and 62
188. limit 187 to (human and english language)
189. limit 188 to (adult <18 to 64 years> or aged <65+ years>)
190. 188 not 189
191. limit 190 to (embryo or infant or child or preschool child <1 to 6 years> or school child <7 to 12 years> or adolescent <13 to 17 years>)
192. 190 not 191
193. 189 or 192
194. remove duplicates from 193

Table C2. EMBASE—Ovid version (continued)

195. 113 or 194

Table C3. Central (EBM Reviews–Cochrane Central Register of Controlled Trials)—Ovid version

Years/issue searched: 3rd Quarter 2005
Search date: August 4, 2005

1. exp meditation/
2. exp yoga/
3. meditat$.mp.
4. cogitat$.ti,ab.
5. Pranayam$.mp.
6. kapalabhati.ti,ab.
7. (yoga or yogic$).mp.
8. mindful$.mp.
9. zen.ti,ab,sh.
10. transcendental.ti,ab.
11. TM-Sidhi.mp.
12. mahayana.ti,ab.
13. hiniyana.ti,ab.
14. theravada$.ti,ab.
15. vajrayana.ti,ab.
16. (vipissana or vipashyana).ti,ab.
17. (dhyana or dyana).ti,ab.
18. dharana.ti,ab.
19. zazen.ti,ab.
20. (kinemantra or KM).ti,ab.
21. (mantra or mantras).mp.
22. (samadhi or samatha).ti,ab.
23. pratyahara.ti,ab.
24. purusha.ti,ab.
25. prakruti.ti,ab.
26. ((Visual or guided) adj5 imagery).mp.
27. ((guided or creative or vivid) adj visualization).ti,ab.
28. pray$.mp.
29. Hesychasm.ti,ab.
30. "lectio divina".ti,ab.
31. bonadona.ti,ab.
32. (qigong or qi gong).mp.
33. ch'i kung.ti,ab.
34. "Tae Eul Ju".ti,ab.
35. "mind-body and relaxation techniques"/ or "mind-body relations (metaphysics)"/
36. tai ji/
37. (tai chi or tai ji).mp.
38. Taijiquan.ti,ab.
39. "open awareness".mp.
40. "focused awareness".mp.
41. "relaxation response".mp.
42. "progressive muscle relaxation".ti,ab.
43. progressive relaxation.ti,ab.
44. "forced nostril breathing".ti,ab.
45. "Uninostril breathing".ti,ab.
46. "unilateral breathing".ti,ab.
47. (Khundalini or Kundalini).mp.
48. raja.ti,ab.
49. hatha.ti,ab.
50. "sudarshan kriya".ti,ab.
51. RRMM.ti,ab.
52. MBSR.ti,ab.
53. MBCT.ti,ab.
54. "zoom lens attention".ti,ab.
55. "Wide-angle lens attention".ti,ab.
56. ("Anapana Sati" or anapanasati).mp.
57. kabat-zinn.ab.
58. or/1-57
59. adult.mp.
60. elderly.mp.
61. middle-age$.mp.
62. aged.hw. or aged.kw. or aged.sh. or "aged 80 and over".sh.
63. or/59-62
64. 58 and 63
65. 58 not 64
66. child$.hw.
67. adolescen$.hw.
68. infan$.hw.
69. minors.hw.
70. neonat$.hw.
71. pediatric$.hw.
72. (nurseries or nursery).hw.
73. or/66-72
74. child$.mp.
75. paediatric$.mp.
76. pediatric$.mp.
77. (neonat$ or perinat$).mp.
78. newborn$.mp.
79. infan$.mp.
80. preemie$.mp.
81. (baby or babies).mp.
82. (nursery or nurseries).mp.
83. toddler$.mp.
84. boy$.mp.
85. girl$.mp.
86. (schoolage$ or (school adj1 age$)).mp.
87. (preschool$ or (pre adj1 school$)).mp.
88. nursery school$.mp.
89. kindergar?en$.mp.
90. (schoolchild$ or (school adj1 child$)).mp.
91. primary school$.mp.
92. elementary school$.mp.
93. (prepubescen$ or postpubescen$ or (pre adj1 pubescen$) or (post adj1 pubescen$)).mp.
94. secondary school$.mp.
95. (pubescen$ or pubert$).mp.
96. adolescen$.mp.
97. juvenil$.mp.
98. underage$.mp.
99. (teen or teens).mp.
100. teenage$.mp.
101. (youth or youths).mp.
102. (highschool$ or (high adj1 school$)).mp.
103. kid$1.mp.
104. offspring.mp.
105. or/74-104
106. infan$.jw.
107. (neonat$ or perinat$).jw.
108. child$.jw.
109. pediatric$.jw.

Table C3. Central (EBM Reviews–Cochrane Central Register of Controlled Trials)—Ovid version (continued)

110. paediatric$.jw.
111. adolescen$.jw.
112. youth$.jw.
113. school$.jw.
114. or/106-113
115. or/105,114
116. 65 and 115
117. 65 not 116
118. 65 not 115
119. 118 or 64
120. exp meditation/
121. Transcendental meditation/
122. exp yoga/
123. meditat$.mp.
124. cogitat$.ti,ab.
125. Pranayam$.mp.
126. kapalabhati.ti,ab.
127. (yoga or yogic$).mp.
128. mindful$.mp.
129. zen.ti,ab,sh.
130. transcendental.ti,ab.
131. TM-Sidhi.mp.
132. mahayana.ti,ab.
133. hiniyana.ti,ab.
134. theravada$.ti,ab.
135. vajrayana.ti,ab.
136. (vipissana or vipashyana).ti,ab.
137. (dhyana or dyana).ti,ab.
138. dharana.ti,ab.
139. zazen.ti,ab.
140. (kinemantra or KM).ti,ab.
141. (mantra or mantras).mp.
142. (samadhi or samatha).ti,ab.
143. pratyahara.ti,ab.
144. purusha.ti,ab.
145. prakruti.ti,ab.
146. ((Visual or guided) adj5 imagery).mp.
147. ((guided or creative or vivid) adj visualization).ti,ab.
148. pray$.mp.
149. Hesychasm.ti,ab.
150. lectio divina.ti,ab.
151. bonadona.ti,ab.
152. (qigong or qi gong).mp.
153. ch'i kung.ti,ab.
154. "Tae Eul Ju".ti,ab.
155. relaxation training/ and (Psychophysiology/ or Breathing Exercise/)
156. "Mental Concentration"/ and (Breathing Exercise/ or relaxation training/)
157. (mind adj body).ti,ab.
158. brain mind relationship/
159. exp Tai Chi/
160. (tai chi or tai ji).mp.
161. Taijiquan.ti,ab.
162. "open awareness".mp.
163. "focused awareness".mp.
164. "relaxation response".mp.
165. "progressive muscle relaxation".ti,ab.
166. progressive relaxation.ti,ab.
167. "forced nostril breathing".ti,ab.
168. "Uninostril breathing".ti,ab.
169. "unilateral breathing".ti,ab.
170. (Khundalini or Kundalini).mp.
171. raja.ti,ab.
172. hatha.ti,ab.
173. "sudarshan kriya".ti,ab.
174. RRMM.ti,ab.
175. MBSR.ti,ab.
176. MBCT.ti,ab.
177. "zoom lens attention".ti,ab.
178. "Wide-angle lens attention".ti,ab.
179. ("Anapana Sati" or anapanasati).mp.
180. kabat-zinn.ab.
181. or/120-180
182. 181 or 58
183. 182 not 58
184. 119 or 183

Table C4. PsycINFO®—Ovid version

Years/issue searched: 1872 to August 2005, week 4
Search date: September 9, 2005

1. exp meditation/
2. exp yoga/
3. exp Guided Imagery/
4. exp Prayer/
5. Autogenic Training/
6. meditat$.mp.
7. cogitat$.ti,ab.
8. Pranayam$.mp.
9. kapalabhati.ti,ab.
10. (yoga or yogic$).mp.
11. mindful$.mp.
12. zen.ti,ab,sh.
13. transcendental.ti,ab.
14. TM-Sidhi.mp.
15. mahayana.ti,ab.
16. hiniyana.ti,ab.
17. theravada$.ti,ab.
18. vajrayana.ti,ab.
19. (vipissana or vipashyana).ti,ab.
20. (dhyana or dyana).ti,ab.
21. dharana.ti,ab.
22. zazen.ti,ab.
23. (kinemantra or KM).ti,ab.
24. (mantra or mantras).mp.
25. (samadhi or samatha).ti,ab.
26. pratyahara.ti,ab.
27. purusha.ti,ab.
28. prakruti.ti,ab.
29. (((Visual or guided) adj3 imagery) and (therap$ or treat$ or interven$)).mp.
30. imagery/ and relaxation therapy/
31. ((guided or creative or vivid) adj visualization).ti,ab.
32. pray$.mp.
33. Hesychasm.ti,ab.
34. lectio divina.ti,ab.
35. bonadona.ti,ab.
36. (qigong or qi gong).mp.
37. ch'i kung.ti,ab.
38. "Tae Eul Ju".ti,ab.
39. relaxation therapy/ and mind.ti,ab.
40. Progressive relaxation therapy/
41. ((mind adj body) and (therap$ or treat$ or interven$ or aware$ or breath$ or relax$ or conscious$)).ti,ab.
42. (tai chi or tai ji).mp.
43. Taijiquan.ti,ab.
44. "open awareness".mp.
45. "focused awareness".mp.
46. "relaxation response".mp.
47. "progressive muscle relaxation".ti,ab.
48. progressive relaxation.ti,ab.
49. "forced nostril breathing".ti,ab.
50. "Uninostril breathing".ti,ab.
51. "unilateral breathing".ti,ab.
52. (Khundalini or Kundalini).mp.
53. raja.ti,ab.
54. hatha.ti,ab.
55. "sudarshan kriya".ti,ab.
56. RRMM.ti,ab.
57. MBSR.ti,ab.
58. MBCT.ti,ab.
59. "zoom lens attention".ti,ab.
60. "Wide-angle lens attention".ti,ab.
61. ("Anapana Sati" or anapanasati).mp.
62. kabat-zinn.ab.
63. or/1-61
64. exp CLINICAL TRIALS/
65. control group/
66. random$.mp.
67. "sampling (experimental)"/ or Biased Sampling/ or Random Sampling/
68. ((singl$ or doubl$ or tripl$ or trebl$) adj10 (blind$ or mask$)).mp.
69. (cross?over or placebo$ or control$ or factorial or sham$).mp.
70. double dummy.mp.
71. ((clin$ or intervention$ or compar$ or experiment$ or preventive or therap$) adj10 (trial$ or study or studies)).mp.
72. Experimental Subjects/ or Experiment volunteers/ or Experiment controls/ or Experimental Replication/
73. clinical research.mp. or exp Treatment Effectiveness Evaluation/
74. Treatment Outcomes/ or Psychotherapeutic outcomes/
75. (outcome$ adj assessment).mp.
76. (longitudinal study or meta analysis or program evaluation or prospective study or retrospective study or treatment outcome study or empirical study or experimental replication or followup study).fc.
77. clinical case report.fc.
78. (clin$ adj25 (trial$ or study or studies or design)).ti,ab.
79. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).ti,ab.
80. (efficacy or effective$ or findings or results).mp.
81. RESEARCH DESIGN/
82. FOLLOW-UP STUDIES/
83. (Follow up adj5 (study or studies or design)).ti,ab.
84. PROSPECTIVE STUDIES/
85. LONGITUDINAL STUDIES/
86. Comorbidity/
87. exp Probability/
88. ((Allocat$ or control$ or assign$ or treatment or compar$ or interven$ or experiment$) and (group or groups)).mp.
89. (group or groups).ti,ab.
90. ((control$ or multicenter or prospectiv$ or retrospectiv$ or evaluation or outcome$ or volunteer$ or subjects or participant$ or compar$) and (trial$ or study or studies or design)).mp.
91. Ss.ab.
92. cohort$.ti,ab.
93. case-control$.ti,ab.

Table C4. PsycINFO® – Ovid Version (continued)

94. Cross sectional.ti,ab.
95. (observational adj5 (study or studies or design)).ti,ab.
96. Longitudinal.mp.
97. Retrospective.ti,ab.
98. risk.ti,ab.
99. Odds ratio.ti,ab.
100. (case adj (comparison or referent)).ti,ab.
101. (Causation or causal$).ti,ab.
102. (Analytic adj (study or studies)).ti,ab.
103. exp Placebo/
104. exp Empirical Methods/
105. Repeated Measures/
106. Between Groups Design/
107. exp Evaluation/
108. cohort analysis/
109. or/64-108
110. 63 and 109
111. limit 110 to (human and english language)
112. limit 111 to adulthood <18+ years>
113. 111 not 112
114. limit 113 to (childhood or adolescence <13 to 17 years>)
115. 113 not 114
116. 112 or 115
117. limit 116 to (chapter or journal or peer reviewed journal or dissertation abstract or report or "review")
118. remove duplicates from 117
119. meta analysis/ or statistical analysis/ or "literature review"/
120. systematic review$.mp.
121. systematic literature review$.mp.
122. meta-analysis.sh.
123. (meta-analys?s or metaanalys?s).ti.
124. evidence-based medicine.mp.
125. quantitative review$.ti,ab.
126. quantitative overview$.ti,ab.
127. quantitative synthes?s.ti.
128. quantitative analys?s.ti,ab.
129. (evidence-based adj (guideline$ or recommendation$)).mp.
130. health planning guideline$.mp.
131. cochrane database of systematic reviews.mp.
132. cdsr.mp.
133. acp journal club.mp.
134. (health tech$ assess$ or hta).mp.
135. technolog$ assess$.mp.
136. evidence based nursing.mp.
137. evidence based mental health.mp.
138. clinical evidence.mp.
139. biomedical technology assessment.sh.
140. evidence report$.mp.
141. or/120-140
142. systematic$.mp.
143. critical.mp.
144. (study and selection).ti,ab.
145. ((predetermined or inclusion) and criteri$).mp.
146. exclusion criteri$.mp.
147. main outcome measure$.mp.
148. "standard$ of care".mp.
149. or/142-148
150. (survey$ or overview$ or review or reviews or search$ or handsearch$).mp.
151. (analys?s or critique or appraisal).mp.
152. (reduction and risk and (death or occurrence)).mp.
153. or/150-152
154. (literature or article$ or publication$ or bibliograph$ or published or unpublished or ciation$ or database$ or internet or reference$ or textbook$ or trial$).mp.
155. meta-analysis.sh.
156. (medline or medlars or pubmed or embase or index medicus or cochrane or scisearch or web of science or psychinfo or psychlit or cinahl or experta medica or science citation index or sciences citation index or biological abstracts).mp.
157. (clinical and studies).mp.
158. (treatment outcome or combine$ or combining or peto or der simonian or dersimonian or fixed effect$ or pooled or pooling or mantel haenszel).mp.
159. or/154-157
160. 149 and 153 and 159
161. 141 or 160
162. case report.ti,sh.
163. editorial.ti,pt.
164. letter.pt.
165. note.pt.
166. or/162-165
167. 161 not 166
168. systematic review$.mp.
169. systematic literature review$.mp.
170. meta-analysis.pt.
171. (meta-analys?s or metaanalys?s).ti.
172. evidence-based medicine.mp.
173. quantitative review$.ti,ab.
174. quantitative overview$.ti,ab.
175. quantitative synthes?s.ti.
176. quantitative analys?s.ti,ab.
177. (evidence-based adj (guideline$ or recommendation$)).mp.
178. consensus development conference.pt.
179. health planning guideline$.mp.
180. guideline.pt.
181. cochrane database of systematic reviews.mp.
182. cdsr.mp.
183. acp journal club.mp.
184. health tech$ assess$.mp.
185. hta.mp.
186. evidence based nursing.mp.
187. evidence based mental health.mp.
188. clinical evidence.mp.
189. technolog$ assess$.mp.
190. evidence report$.mp.
191. or/168-190
192. systematic$.mp.
193. critical.mp.
194. (study and selection).ti,ab.
195. ((predetermined or inclusion) and criteri$).mp.

Table C4. PsycINFO® – Ovid Version (continued)

196. exclusion criteri$.mp.
197. main outcome measure$.mp.
198. "standard$ of care".mp.
199. or/192-198
200. (survey$ or overview$ or review or reviews or search$ or handsearch$).mp.
201. (analys?s or critique or appraisal).mp.
202. (reduction and risk and (death or occurrence)).mp.
203. or/200-202
204. (literature or article$ or publication$ or bibliograph$ or published or unpublished or ciation$ or database$ or internet or reference$ or textbook$ or trial$).mp.
205. meta-analysis.sh.
206. (medline or medlars or pubmed or embase or index medicus or cochrane or scisearch or web of science or psychinfo or psychlit or cinahl or experta medica or science citation index or sciences citation index or biological abstracts).mp.
207. (clinical and studies).mp.
208. (treatment outcome or combine$ or combining or peto or der simonian or dersimonian or fixed effect$ or pooled or pooling or mantel haenszel).mp.
209. or/204-207
210. 199 and 203 and 209
211. 191 or 210
212. case report.ti,sh.
213. editorial.ti,pt.
214. letter.pt.
215. newspaper article.pt.
216. comment.pt.
217. or/212-216
218. 211 not 217
219. meta-analysis.pt.
220. (meta-anal$ or metaanal$).mp.
221. (((quantitativ$ adj3 review$1) or quantitativ$) adj3 overview$).mp.
222. (((systematic adj3 review$1) or systematic) adj3 overview$1).mp.
223. (((methodologic adj3 review$1) or methodologic) adj3 overview$).mp.
224. (integrat$ adj5 research).mp.
225. (quantitativ$ adj3 synthes$).mp.
226. or/219-225
227. review.pt. or (review$ or overview$).mp.
228. (medline or medlars or pubmed or index medicus or embase or cochrane).mp.
229. (scisearch or web of science or psycinfo or psychinfo or cinahl or cinhal).mp.
230. (excerpta medica or psychlit or psyclit or current contents or science citation index or sciences citation index).mp.
231. (hand search$ or manual search$).mp.
232. ((((electronic adj3 database$) or bibliographic) adj3 database$) or periodical index$).mp.
233. (pooling or pooled or mantel haenszel).mp.
234. (peto or der simonian or dersimonian or fixed effect$).mp.
235. ((combine$ or combining) adj5 (data or trial or trials or studies or study or result or results)).mp.
236. or/228-235
237. 227 and 236
238. 226 or 237
239. (hta$ or health technology assessment$ or biomedical technology assessment$).mp.
240. technology assessment, biomedical/ or biomedical technology asssessment/
241. 239 or 240
242. 238 or 241
243. 63 and (119 or 167 or 218 or 242)
244. 243 not 118
245. limit 244 to (100 childhood or 200 adolescence)
246. 244 not 245
247. limit 246 to (human and english language)
248. remove duplicates from 247
249. 118 or 248

Table C5. AMED (Allied and Complementary Medicine)—Ovid version

Years/issue searched: 1985 to September 2005
Search date: September 30, 2005

1. exp meditation/
2. exp yoga/
3. meditat$.mp.
4. cogitat$.ti,ab.
5. Pranayam$.mp.
6. kapalabhati.ti,ab.
7. (yoga or yogic$).mp.
8. mindful$.mp.
9. zen.ti,ab,sh.
10. transcendental.ti,ab.
11. TM-Sidhi.mp.
12. mahayana.ti,ab.
13. hiniyana.ti,ab.
14. theravada$.ti,ab.
15. vajrayana.ti,ab.
16. (vipissana or vipashyana).ti,ab.
17. (dhyana or dyana).ti,ab.
18. dharana.ti,ab.
19. zazen.ti,ab.
20. (kinemantra or KM).ti,ab.
21. (mantra or mantras).mp.
22. (samadhi or samatha).ti,ab.
23. pratyahara.ti,ab.
24. purusha.ti,ab.
25. prakruti.ti,ab.
26. visualization/
27. ((Visual or guided) adj5 imagery).mp.
28. ((guided or creative or vivid) adj visualization).ti,ab.
29. pray$.mp.
30. Hesychasm.ti,ab.
31. "lectio divina".ti,ab.
32. bonadona.ti,ab.
33. (qigong or qi gong).mp.
34. ch'i kung.ti,ab.
35. "Tae Eul Ju".ti,ab.
36. "mind body medicine"/
37. tai chi/
38. (tai chi or tai ji).mp.
39. Taijiquan.ti,ab.
40. "open awareness".mp.
41. "focused awareness".mp.
42. relaxation/
43. "relaxation response".mp.
44. "progressive muscle relaxation".ti,ab.
45. progressive relaxation.ti,ab.
46. breathing therapies/
47. "forced nostril breathing".ti,ab.
48. "Uninostril breathing".ti,ab.
49. "unilateral breathing".ti,ab.
50. (Khundalini or Kundalini).mp.
51. raja.ti,ab.
52. hatha.ti,ab.
53. "sudarshan kriya".ti,ab.
54. RRMM.ti,ab.
55. MBSR.ti,ab.
56. MBCT.ti,ab.
57. "Wide-angle lens attention".ti,ab.
58. ("Anapana Sati" or anapanasati).mp.
59. or/1-58
60. limit 59 to english
61. ((singl$ or doubl$ or trebl$ or tripl$) and (blind$ or mask$)).mp.
62. PLACEBOS/ or placebo$.mp.
63. random$.mp.
64. RESEARCH DESIGN/
65. (control$ or prospectiv$ or volunteer$).ti,ab.
66. "control (research)".mp.
67. (cross?over or factorial or sham$).mp.
68. (meta?analy$ or systematic review$).mp.
69. exp research/
70. exp CLINICAL TRIALS/
71. (cross?over or placebo$ or control$ or factorial or sham$).mp.
72. double dummy.mp.
73. ((clin$ or intervention$ or compar$ or experiment$ or preventive or therap$) adj10 (trial$ or study or studies)).mp.
74. (outcome$ adj assessment).mp.
75. (efficacy or effective$ or findings or results).mp.
76. RESEARCH DESIGN/
77. FOLLOW-UP STUDIES/
78. (Follow up adj5 (study or studies or design)).ti,ab.
79. PROSPECTIVE STUDIES/
80. LONGITUDINAL STUDIES/
81. Comorbidity/
82. exp Probability/
83. ((Allocat$ or control$ or assign$ or treatment or compar$ or interven$ or experiment$) and (group or groups)).mp.
84. (group or groups).ti,ab.
85. ((control$ or multicenter or prospectiv$ or retrospectiv$ or evaluation or outcome$ or volunteer$ or subjects or participant$ or compar$) and (trial$ or study or studies or design)).mp.
86. Ss.ab.
87. cohort$.ti,ab.
88. case-control$.ti,ab.
89. Cross sectional.ti,ab.
90. (observational adj5 (study or studies or design)).ti,ab.
91. Longitudinal.mp.
92. Retrospective.ti,ab.
93. risk.ti,ab.
94. Odds ratio.ti,ab.
95. (case adj (comparison or referent)).ti,ab.
96. (Causation or causal$).ti,ab.
97. (Analytic adj (study or studies)).ti,ab.
98. RANDOMIZED CONTROLLED TRIAL.pt.
99. CONTROLLED CLINICAL TRIAL.pt.
100. RANDOMIZED CONTROLLED TRIALS/
101. RANDOM ALLOCATION/

Table C5. AMED (Allied and Complementary Medicine)—Ovid version (continued)

102. DOUBLE BLIND METHOD/
103. SINGLE-BLIND METHOD/
104. CLINICAL TRIAL.pt.
105. COMPARATIVE STUDY/
106. exp COHORT STUDIES/
107. Age factors/
108. Comorbidity/
109. exp Risk/
110. (therapy or treat$).mp.
111. (epidemiologic$ adj (study or studies)).ti,ab.
112. clinical research.mp.
113. or/61-112
114. 113 and 60
115. meta-analysis.pt.
116. (meta-anal$ or metaanal$).mp.
117. (((quantitativ$ adj3 review$1) or quantitativ$) adj3 overview$).mp.
118. (((systematic adj3 review$1) or systematic) adj3 overview$1).mp.
119. (((methodologic adj3 review$1) or methodologic) adj3 overview$).mp.
120. (integrat$ adj5 research).mp.
121. (quantitativ$ adj3 synthes$).mp.
122. or/115-121
123. review.pt. or (review$ or overview$).mp.
124. (medline or medlars or pubmed or index medicus or embase or cochrane).mp.
125. (scisearch or web of science or psycinfo or psychinfo or cinahl or cinhal).mp.
126. (excerpta medica or psychlit or psyclit or current contents or science citation index or sciences citation index).mp.
127. (hand search$ or manual search$).mp.
128. ((((electronic adj3 database$) or bibliographic) adj3 database$) or periodical index$).mp.
129. (pooling or pooled or mantel haenszel).mp.
130. (peto or der simonian or dersimonian or fixed effect$).mp.
131. ((combine$ or combining) adj5 (data or trial or trials or studies or study or result or results)).mp.
132. or/124-131
133. 123 and 132
134. 122 or 133
135. (hta$ or health technology assessment$ or biomedical technology assessment$).mp.
136. technology assessment, biomedical/ or biomedical technology asssessment/
137. 135 or 136
138. 134 or 137
139. 60 and 138
140. 114 or 139

Table C6. CINAHL® (Cumulative Index to Nursing and Allied Health Literature)—Ovid Version

Years/issue searched: 1982 to September 2005, week 5
Search date: October 4, 2005

1. exp "MEDITATION (IOWA NIC)"/ or exp MEDITATION/
2. yoga/ or mind body techniques/
3. exp Guided Imagery/
4. exp Prayer/
5. exp Tai Chi/
6. exp Relaxation Techniques/
7. exp "progressive muscle relaxation (iowa nic)"/
8. exp "AUTOGENIC TRAINING (IOWA NIC)"/
9. meditat$.mp.
10. cogitat$.ti,ab.
11. Pranayam$.mp.
12. kapalabhati.ti,ab.
13. (yoga or yogic$).mp.
14. mindful$.mp.
15. zen.ti,ab,sh.
16. transcendental.ti,ab.
17. TM-Sidhi.mp.
18. mahayana.ti,ab.
19. hiniyana.ti,ab.
20. theravada$.ti,ab.
21. vajrayana.ti,ab.
22. (vipissana or vipashyana).ti,ab.
23. (dhyana or dyana).ti,ab.
24. dharana.ti,ab.
25. zazen.ti,ab.
26. (kinemantra or KM).ti,ab.
27. (mantra or mantras).mp.
28. (samadhi or samatha).ti,ab.
29. pratyahara.ti,ab.
30. purusha.ti,ab.
31. prakruti.ti,ab.
32. ((Visual or guided) adj5 imagery).mp.
33. ((guided or creative or vivid) adj visualization).ti,ab.
34. pray$.mp.
35. Hesychasm.ti,ab.
36. "lectio divina".ti,ab.
37. bonadona.ti,ab.
38. (qigong or qi gong).mp.
39. ch'i kung.ti,ab.
40. "Tae Eul Ju".ti,ab.
41. (tai chi or tai ji).mp.
42. Taijiquan.ti,ab.
43. "open awareness".mp.
44. "focused awareness".mp.
45. "relaxation response".mp.
46. "progressive muscle relaxation".ti,ab.
47. progressive relaxation.ti,ab.
48. "forced nostril breathing".ti,ab.
49. "Uninostril breathing".ti,ab.
50. "unilateral breathing".ti,ab.
51. (Khundalini or Kundalini).mp. [mp=title, subject heading word, abstract, instrumentation]
52. raja.ti,ab.
53. hatha.ti,ab.
54. "sudarshan kriya".ti,ab.
55. RRMM.ti,ab.
56. MBSR.ti,ab.
57. MBCT.ti,ab.
58. "Wide-angle lens attention".ti,ab.
59. ("Anapana Sati" or anapanasati).mp. [mp=title, subject heading word, abstract, instrumentation]
60. or/1-59
61. random assignment/
62. exp random sample/
63. crossover design/
64. exp clinical trials/
65. exp comparative studies/
66. "control (research)".mp.
67. control group/
68. factorial design/
69. quasi-experimental studies/
70. nonrandomized trials/
71. placebos/
72. meta analysis/
73. clinical nursing research.mp. or clinical research/
74. community trials/ or experimental studies/ or one-shot case study/ or pretest-posttest design/ or solomon four-group design/ or static group comparison/ or study design/
75. (clinical trial or systematic review).pt.
76. random$.mp.
77. ((singl$ or doubl$ or tripl$ or trebl$) adj25 (blind$ or mask$ or dummy)).mp.
78. (cross?over or placebo$ or control$ or factorial or sham$).mp.
79. ((clin$ or intervention$ or compar$ or experiment$ or preventive or therapeutic) adj10 trial$).mp.
80. (meta?analy$ or systematic review$).mp.
81. convenience sample/ or sample size/
82. exp research, allied health/ or research, medical/ or research, nursing/
83. research question/
84. nursing practice, research-based/
85. exp research methodology/
86. exp evaluation research/
87. concurrent prospective studies/ or prospective studies/
88. (nursing interventions or research or review or proceedings or "tables/charts" or protocol).pt.
89. (Follow up adj5 (study or studies or design)).ti,ab.
90. exp COHORT STUDIES/
91. exp CROSS SECTIONAL STUDIES/
92. exp CASE CONTROL STUDIES/
93. Epidemiologic research/
94. Seroprevalence studies/
95. exp Causal Attribution/
96. Reproducibility of results/
97. Correlational Study/

Table C6. CINAHL® (Cumulative Index to Nursing and Allied Health Literature)—Ovid version (continued)

98. Age factors/
99. Comorbidity/
100. Odds ratio/
101. Relative Risk/ or Risk Assessment/
102. Probability/
103. Patient Selection/
104. ((Allocat$ or control$ or assign$ or treatment or compar$ or interven$ or experiment$) and (group or groups)).mp. [mp=title, subject heading word, abstract, instrumentation]
105. (group or groups).ti,ab.
106. (control$ or prospectiv$ or retrospectiv$ or volunteer$ or participant$ or compar$).mp. and (trial$ or study or studies or design).ti,ab,sh. [mp=title, subject heading word, abstract, instrumentation]
107. cohort$.ti,ab.
108. case-control$.ti,ab.
109. Cross sectional.ti,ab.
110. (observational adj5 (study or studies or design)).ti,ab.
111. Longitudinal.mp.
112. Retrospective.ti,ab.
113. Relative risk.ti,ab.
114. Odds ratio.ti,ab.
115. (case adj (comparison or referent)).ti,ab.
116. (Causation or causal$).ti,ab.
117. (Analytic adj (study or studies)).ti,ab.
118. or/61-117
119. 60 and 118
120. limit 119 to english
121. limit 120 to (adult <19 to 44 years> or middle age <45 to 64 years> or aged <65 to 79 years> or "aged <80 and over>")
122. 120 not 121
123. limit 122 to (fetus or newborn infant or infant <1 to 23 months> or preschool child <2 to 5 years> or child <6 to 12 years> or adolescence <13 to 18 years>)
124. 122 not 123
125. 121 or 124
126. meta-analysis.pt.
127. (meta-anal$ or metaanal$).mp.
128. (((quantitativ$ adj3 review$1) or quantitativ$) adj3 overview$).mp.
129. (((systematic adj3 review$1) or systematic) adj3 overview$1).mp.
130. (((methodologic adj3 review$1) or methodologic) adj3 overview$).mp.
131. (integrat$ adj5 research).mp.
132. (quantitativ$ adj3 synthes$).mp.
133. or/126-132
134. review.pt. or (review$ or overview$).mp.
135. (medline or medlars or pubmed or index medicus or embase or cochrane).mp.
136. (scisearch or web of science or psycinfo or psychinfo or cinahl or cinhal).mp.
137. (excerpta medica or psychlit or psyclit or current contents or science citation index or sciences citation index).mp.
138. (hand search$ or manual search$).mp.
139. ((((electronic adj3 database$) or bibliographic) adj3 database$) or periodical index$).mp.
140. (pooling or pooled or mantel haenszel).mp.
141. (peto or der simonian or dersimonian or fixed effect$).mp.
142. ((combine$ or combining) adj5 (data or trial or trials or studies or study or result or results)).mp.
143. or/135-142
144. 134 and 143
145. 133 or 144
146. (hta$ or health technology assessment$ or biomedical technology assessment$).mp.
147. technology assessment, biomedical/ or biomedical technology asssessment/
148. 146 or 147
149. 145 or 148
150. 60 and 149
151. limit 150 to english
152. limit 151 to (adult <19 to 44 years> or middle age <45 to 64 years> or aged <65 to 79 years> or "aged <80 and over>")
153. 151 not 152
154. limit 153 to (fetus or newborn infant or infant <1 to 23 months> or preschool child <2 to 5 years> or child <6 to 12 years> or adolescence <13 to 18 years>)
155. 153 not 154
156. 152 or 155
157. 125 or 156

Table C7. Web of Science®–Institute for Scientific Information—The Thomson Corporation

Years/issue searched: 1900 to 2005
Search date: September 21, 2005

#1 TS=meditat* OR TS=yoga OR TS=yogic OR TS=(tai chi) OR TS=(tai ji) OR TS=(qi gong) OR TS=qigong OR TS=pray* OR TS=mantra* OR TS=(progressive muscle relaxation) OR TS=(relaxation response) OR TS=unilateral W/1 breath* OR TS=(guided imagery) OR TS=transcendental OR TS=zen OR TS=rrmm OR TS=mbsr OR TS=mbct OR TS=(unilateral forced) OR TS=(forced nostril) OR TS=(progressive relaxation) OR TS=mindful*

#2 TS=psychotherap* OR TS=sympt* OR TS=clinic* OR TS=illness* OR TS=rehab* OR TS=heal OR TS=healing OR TS=health OR TS=medicin* OR TS=medical* OR TS=therap* OR TS=counsel* OR TS=interven* OR TS=physiol* OR TS=heart* OR TS=cardiac OR TS=stress* OR TS=analges* OR TS=anxiety OR TS=stress* OR TS=cancer* OR TS=psychol* OR TS=metabol* OR TS=respirat* OR TS=neuro* OR TS=participants OR TS=patients OR TS=(control group*)

#3 SO=psychotherap* OR SO=sympt* OR SO=clinic* OR SO=illness* OR SO=rehab* OR SO=heal OR SO=healing OR SO=health OR SO=medicin* OR SO=medical* OR SO=therap* OR SO=counsel* OR SO=interven* OR SO=physiol* OR SO=heart* OR SO=cardiac OR SO=stress* OR SO=analges* OR SO=anxiety OR SO=stress* OR SO=cancer* OR SO=psychol* OR SO=metabol* OR SO=respirat* OR SO=neuro*

#4 #2 OR #3

#5 #1 AND #4

#6 #5
DocType=All document types; Language=English; Databases=SCI-EXPANDED, SSCI, A&HCI; Timespan=1900-2005

#7 #5
DocType=Art Exhibit Review OR Biographical-Item OR Book Review OR Dance Performance Review OR Database Review OR Fiction, Creative Prose OR Film Review OR Hardware Review OR Music Performance Review OR Music Score OR Music Score Review OR News Item OR Poetry OR Script OR Software Review OR TV Review, Radio Review OR Theater Review; Language=All languages; Databases=SCI-EXPANDED, SSCI, A&HCI; Timespan=1900-2005

#8 #6 NOT #7

Table C8. CSA Neurosciences Abstracts—CSA Illumina

Years/issue searched: 1982 to 2005 **Search date:** August 4, 2005
(((meditat* or yoga or yogic) or ((tai chi) or (tai ji) or (qi gong)) or (qigong or pray* or mantra*) or ((progressive muscle relaxation) or (relaxation response) or (unilateral breath*)) or ((guided imagery) or transcendental or zen) or AB=(rrmm or mbsr or mbct) or ((forced nostril breath*) or (progressive relaxation) or mindful*) or AB=(pmr or cogitat*)) and (PT=bibliography or PT=(book monograph) or PT=conference or PT=dissertation or PT=(journal article) or PT=report or PT=review or PT=(training manual))) not ((rat or rats or mantis* or pigeon*) or ((mice or mouse) or sheep or pig or pigs))

Table C9. Cochrane Complementary Medicine Trials Register and CAMPAIN (Complementary and Alternative Medicine and Pain Database)

Years/issue searched: 1983 to 2003 **Search date:** October 25, 2005
Meditation or meditate or meditating or mindful or mindfulness or qigong or qi gong or tai chi or taiji or yoga or yogic or relaxation response or autogenic or kundalini or pranayama or pranayam or samahdi or imagery or visualization or mantra or cogitation or mbsr or kinemantra or dyana or dhyana or naam or anapanasati or mbct or hatha or raja or vipashyana or vipassana

Table C10. CDSR- (EBM Reviews–Cochrane Database of Systematic Reviews)—Ovid version

Years/issue searched: 3rd Quarter 2005
Search date: September 9, 2005

1. exp meditation/
2. exp yoga/
3. meditat$.mp.
4. cogitat$.ti,ab.
5. Pranayam$.mp.
6. kapalabhati.ti,ab.
7. (yoga or yogic$).mp.
8. mindful$.mp.
9. zen.ti,ab,sh.
10. transcendental.ti,ab.
11. TM-Sidhi.mp.
12. mahayana.ti,ab.
13. hiniyana.ti,ab.
14. theravada$.ti,ab.
15. vajrayana.ti,ab.
16. (vipissana or vipashyana).ti,ab.
17. (dhyana or dyana).ti,ab.
18. dharana.ti,ab.
19. zazen.ti,ab.
20. (kinemantra or KM).ti,ab.
21. (mantra or mantras).mp.
22. (samadhi or samatha).ti,ab.
23. pratyahara.ti,ab.
24. purusha.ti,ab.
25. prakruti.ti,ab.
26. ((Visual or guided) adj5 imagery).mp.
27. ((guided or creative or vivid) adj visualization).ti,ab.
28. pray$.mp.
29. Hesychasm.ti,ab.
30. "lectio divina".ti,ab.
31. bonadona.ti,ab.
32. (qigong or qi gong).mp.
33. ch'i kung.ti,ab.
34. "Tae Eul Ju".ti,ab.
35. "mind-body and relaxation techniques"/ or "mind-body relations (metaphysics)"/
36. tai ji/
37. (tai chi or tai ji).mp.
38. Taijiquan.ti,ab.
39. "open awareness".mp.
40. "focused awareness".mp.
41. "relaxation response".mp.
42. "progressive muscle relaxation".ti,ab.
43. progressive relaxation.ti,ab.
44. "forced nostril breathing".ti,ab.
45. "Uninostril breathing".ti,ab.
46. "unilateral breathing".ti,ab.
47. (Khundalini or Kundalini).mp.
48. raja.ti,ab.
49. hatha.ti,ab.
50. "sudarshan kriya".ti,ab.
51. RRMM.ti,ab.
52. MBSR.ti,ab.
53. MBCT.ti,ab.
54. "zoom lens attention".ti,ab.
55. "Wide-angle lens attention".ti,ab.
56. ("Anapana Sati" or anapanasati).mp.
57. kabat-zinn.ab.
58. or/1-57

Table C11. OCLC Article First and OCLC Proceedings First—OCLC First Search

Years/issue searched: 1993 to 2005 **Search date:** September 22, 2005

(kw: meditat* OR kw: yoga OR kw: yogic OR (kw: tai and kw: chi) OR (kw: tai and kw: ji) OR (kw: qi and kw: gong) OR kw: qigong OR kw: pray* OR kw: mantra* OR (kw: progressive and kw: muscle and kw: relaxation) OR (kw: relaxation and kw: response) OR ((kw: unilateral and kw: W/1 and kw: breath*) OR (kw: guided and kw: imagery)) OR kw: transcendental OR kw: zen OR kw: rrmm OR kw: mbsr OR kw: mbct OR (kw: unilateral and kw: forced) OR (kw: forced and kw: nostril) OR (kw: progressive and kw: relaxation) OR kw: mindful*) and ((kw: psychotherap* OR kw: sympt* OR kw: clinic* OR kw: illness* OR kw: rehab* OR kw: heal OR kw: healing) or (kw: health OR kw: medicin* OR kw: medical* OR kw: therap* OR kw: counsel* OR kw: interven* OR kw: physiol*) or (kw: heart* OR kw: cardiac OR kw: stress* OR kw: analges* OR kw: anxiety OR kw: stress* OR kw: cancer* OR kw: psychol*) or (kw: metabol* OR kw: respirat*) or (kw: neurosci* OR kw: neurol* OR kw: neuron+) or (kw: participant+ OR kw: patient+ OR kw: control w group*)).

Table C12. NLM Gateway–National Library of Medicine

Years/issue searched: 1950 to 2005 **Search date:** October 25, 2005

meditation or yoga or tai chi or qigong

Table C13. Current Clinical Trials—Biomed Central

Years/issue searched: 1998 to 2005
Search date: October 24, 2005

imagery OR mindful* OR "tai chi" OR qigong OR yoga OR 'qi gong' OR meditation

Table C14. National Research Register

Years/issue searched: 2000 to 2005
Search date: October 24, 2005

imagery OR mindful* OR "tai chi" OR qigong OR yoga OR 'qi gong' OR meditation

Table C15. CRISP (Computer Retrieval of Information on Scientific Projects)

Years/issue searched: 2005 to 2006
Search date: February 21, 2006

$(meditate | meditation | meditating | mindful | mindfulness | yoga | qigong

Appendix D. Review Forms

D1. Title and abstract screening form

For screening, the criteria will be suitably broad to exclude only those articles that are obviously irrelevant to the descriptive overview (topic I); the review of evidence on the state of the research literature (topic II); and the effects, efficacy and effectiveness of meditation (topics III to V).

For each title/abstract, go through the five rejection criteria R1 to R5, in any order. Any article must clearly satisfy one of the criteria below in order to be considered clearly irrelevant. Stop at the first "Yes" and classify the study as "Do not retrieve article". Otherwise, classify it as "Retrieve article". If it is unclear whether an article meets any of the criteria below, the article will be considered eligible for retrieval and further review.

Reference ID #:	Reviewer ID #:
Author(s):	Year of Publication:

Criteria of Irrelevance:

	Yes	No	Unsure
R1: Non-English study	☐	☐	☐
R2: Study participants clearly < 18 years old	☐	☐	☐
R3: Clearly not on meditation	☐	☐	☐
R4: Case report/case series/editorial/letter/lay press	☐	☐	☐
R5: Total study population clearly < 10	☐	☐	☐

Decisions:

Retrieve article ☐
Do not retrieve article ☐

Specific instructions:

R2: Primary studies that clearly indicate that only pediatric populations (< 18 years) were studied will be considered irrelevant.
R3: An article will be considered irrelevant if: 1) the main topic of the article does not include the word meditation or a synonym, 2) the article does not include any of the specific terms listed in the list of potentially relevant techniques, or 3) it is clear that the topic is not related to meditation or any of the meditation practices.

D2. Inclusion and exclusion form

Reference ID #:	Reviewer ID #:		
Author(s):	Year of Publication:		
1. TOPIC/INTERVENTION			
a. Primary research evaluating the effects of meditation	Yes ☐	No ☐	Unsure ☐
b. Secondary research on practice of meditation	Yes ☐	No ☐	Unsure ☐
c. Do the authors of the study explicitly describe the intervention as meditation or as involving a meditative component?	Yes ☐	No ☐	Unsure ☐
d. Does the TEP consider the intervention as a meditation practice or involving a meditative component?	Yes ☐	No ☐	Unsure ☐
e. Does the intervention satisfy the operational criteria developed by consensus?	Yes ☐	No ☐	Unsure ☐
2. DESIGN			
Does the study satisfy any of the following designs?	Yes ☐	No ☐	Unsure ☐
a. Narrative/systematic review	Yes ☐	No ☐	Unsure ☐
b. RCT/NRCT	Yes ☐	No ☐	Unsure ☐
c. Prospective cohort study with concurrent control group	Yes ☐	No ☐	Unsure ☐
d. Prospective cohort study with historical control group	Yes ☐	No ☐	Unsure ☐
e. Retrospective cohort study with control group (any type)	Yes ☐	No ☐	Unsure ☐
f. Case-control study	Yes ☐	No ☐	Unsure ☐
g. Cross-sectional study with controls	Yes ☐	No ☐	Unsure ☐
h. Before-and-after study	Yes ☐	No ☐	Unsure ☐
3. CONTROLS			
a. Does the study provide a comparison or control condition population with which to compare the intervention group?	Yes ☐	No ☐	Unsure ☐
4. PARTICIPANTS			
a. Does the study population consist of adults (i.e.., individuals who are ≥ 18 years of age), or Does the study population include a subgroup of adults for which separate data can be analyzed?	Yes ☐	No ☐	Unsure ☐
b. Study population is ≥10?	Yes ☐	No ☐	Unsure ☐
5. OUTCOMES			
a. Study reports numeric data on at least one health-related outcome?	Yes ☐	No ☐	Unsure ☐

REVIEWER'S DECISION:

TO INCLUDE IN Q1		To INCLUDE IN Q2	
• Meets 1b	☐	• Meets 1a	☐
• Meets at least two of 1c, 1d, or 1e	☐	• Meets at least two of 1c, 1d, or 1e	☐
• Meets 2a	☐	• Meets any from 2b to 2h	☐
		• Meets all from 3 to 5	☐
INCLUDE Q1 Yes ☐ No ☐ Unsure ☐		INCLUDE Q2 Yes ☐ No ☐ Unsure ☐	
TEP TO VERIFY INTERVENTION	☐	Useful background information (TO FLAG): ☐	

Intervention Studies

Jadad scale—RCTs

ITEMS	YES	NO
1. Was the study described as randomized (this includes the use of words such as randomly, random and randomization)?	1	0
2. Was the study described as double-blind?	1	0
3. Was there a description of withdrawals and drop-outs?	1	0
4. Method to generate the sequence of randomization was described and was appropriate (e.g. table of random numbers, computer generated, coin tossing, etc.)	1	0
5. Method of double-blinding described and appropriate (identical placebo, active placebo, or dummy)?	1	0
6. Method of randomization described and it was inappropriate (allocated alternately, according to date of birth, hospital number, etc.)?	-1	0
7. Method of double-blinding described but it was inappropriate (comparison of tablet vs. injection with no double dummy)?	-1	0
OVERALL SCORE (Maximum 5)		

Schultz concealment of treatment allocation—RCTs

Concealment of treatment allocation	☐ Adequate ☐ Inadequate ☐ Unclear
Adequate:	Central randomization; numbered/coded containers; drugs prepared by pharmacy; serially numbered, opaque, sealed envelopes
Inadequate:	Alternation, use of case record numbers, dates of birth or day of week; open lists
Unclear:	Allocation concealment approach not reported or fits neither above category

Jadad Scale (modified)—NRCTs

ITEMS	**YES**	**NO**
2. Was the study described as double-blind?	1	0
3. Was there a description of withdrawals and drop-outs?	1	0
5. Method of double-blinding described and appropriate (identical placebo, active placebo, dummy)?	1	0
6. Method of randomization described and it was **in**appropriate (allocated alternately, according to date of birth, hospital number, etc.)?	-1	0
7. Method of double-blinding described but it was **in**appropriate (comparison of tablet vs. injection with no double dummy)?	-1	0
OVERALL SCORE (Maximum 3)		

Questions for quality assessment for before-and-after studies

1. Was the study population representative of the target population?	YES	NO
2. Was the method of outcome assessment the same for the pre- and post- intervention periods for all participants?	YES	NO
3. Were outcome assessors blind to intervention and assessment period?	YES	NO
4. Did the study report the number of and reasons for study withdrawals?	YES	NO

Observational Analytical Studies

Newcastle-Ottawa Scale for case-control studies

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Exposure categories. A maximum of two stars can be given for Comparability.

Selection

1) Is the case definition adequate?
   - a) Yes, with independent validation * (1)
   - b) Yes, e.g. record linkage or based on self reports (0)
   - c) No description (0)

2) Representativeness of the cases
   - a) Consecutive or obviously representative series of cases * (1)
   - b) Potential for selection biases or not stated (0)

3) Selection of Controls
   - a) Community controls * (1)
   - b) Hospital controls (0)
   - c) No description (0)

4) Definition of Controls
   - a) No history of disease (endpoint) * (1)
   - b) No description of source (0)

Comparability

1) Comparability of cases and controls on the basis of the design or analysis
   - a) Study controls for _______________ (select the most important factor.) * (1)
   - b) Study controls for any additional factor * (this criteria could be modified to indicate specific control for a second important factor.) (1)

Exposure

1) Ascertainment of exposure
   - a) Secure record (e.g. surgical records) * (1)
   - b) Structured interview where blind to case/control status * (1)
   - c) Interview not blinded to case/control status (0)
   - d) Written self report or medical record only (0)
   - e) No description (0)

2) Same method of ascertainment for cases and controls
   - a) Yes * (1)
   - b) No (0)

3) Nonresponse rate
   - a) Same rate for both groups * (1)
   - b) Non respondents described (0)
   - c) Rate different and no designation (0)

Newcastle-Ottawa Scale for cohort studies

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Outcome categories. A maximum of two stars can be given for Comparability

Selection

1) Representativeness of the exposed cohort
   - a) Truly representative of the average _______________ (describe) in the community * (1)
   - b) Somewhat representative of the average ______________ in the community * (1)
   - c) Selected group of users e.g. nurses, volunteers
   - d) No description of the derivation of the cohort
2) Selection of the non exposed cohort
   - a) Drawn from the same community as the exposed cohort * (1)
   - b) Drawn from a different source
   - c) No description of the derivation of the non exposed cohort
3) Ascertainment of exposure
   - a) Secure record (e.g. surgical records) * (1)
   - b) Structured interview
   - c) Written self report
   - d) No description
4) Demonstration that outcome of interest was not present at start of study
   - a) Yes * (1)
   - b) No

Comparability

5) Comparability of cohorts on the basis of the design or analysis
   - a) Study controls for _____________ (select the most important factor) * (1)
   - b) Study controls for any additional factor * (this criteria could be modified to indicate specific control for a second important factor) (1)

Outcome

6) Assessment of outcome
   - a) Independent blind assessment * (1)
   - b) Record linkage * (1)
   - c) Self report
   - d) No description
7) Was follow-up long enough for outcomes to occur
   - a) Yes (select an adequate follow up period for outcome of interest) * (1)
   - b) No
8) Adequacy of followup of cohorts
   - a) Complete follow up - all subjects accounted for * (1)
   - b) Subjects lost to follow up unlikely to introduce bias - small number lost - > ____ % (select an adequate %) follow up, or description provided of those lost) * (1)
   - c) Follow up rate < ____% (select an adequate %) and no description of those lost
   - d) No statement

Newcastle-Ottawa Scale (modified) for cross-sectional studies

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Outcome categories. A maximum of two stars can be given for Comparability

Selection

1) Representativeness of the study group
   - a) Truly representative of the average _______________ (describe) in the community * (1)
   - b) Somewhat representative of the average ______________ in the community * (1)
   - c) Selected group of users e.g. nurses, volunteers
   - d) No description of the derivation of the cohort

2) Selection of the comparison group
   - a) Drawn from the same community as the study group * (1)
   - b) Drawn from a different source
   - c) No description of the derivation of the comparison group

3) Ascertainment of exposure
   - a) Secure record (e.g., surgical records) * (1)
   - b) Structured interview
   - c) Written self report
   - d) No description

Comparability

5) Comparability of cohorts on the basis of the design or analysis
   - a) Study controls for _____________ (select the most important factor) * (1)
   - b) Study controls for any additional factor * (this criteria could be modified to indicate specific control for a second important factor) (1)

Outcome

6) Assessment of outcome
   - a) Independent blind assessment * (1)
   - b) Record linkage * (1)
   - c) Self report
   - d) No description

D4. Data extraction form

1. GENERAL INFORMATION

Reference ID:				Reviewer ID		Verifier ID	
First author				Year			
Country				Publication type			
Specify source of funding: (Check all that apply)							
Pharmaceutical industry	☐	Industry, other than pharmaceutical	☐	Government agency	☐	Foundation/charity	☐
Internal funds	☐	Professional organizations	☐	Other	☐	Specify:	

2. SPECIFIC INFORMATION

Study characteristics

Study Setting					
Acute care hospital ☐		Community ☐		Complementary Medicine practice ☐	
University ☐		Primary care/outpatient service ☐		Extended care facility ☐	
Other ☐		Specify:			
Study design					
RCT ☐	NRCT ☐	Cross-sectional ☐	Cohort ☐	Case-control ☐	Before-and-after ☐
Aim(s) of the study:					

Population characteristics:

Target population				**Type of primary health problem/condition/population (describe)**	
Clinical population only ☐	Normals only ☐	Both normal and clinical ☐			
If health problem, specify body system/problem involved (Check all that apply)				Selection criteria for participation in study	
Circulatory/Cardio-vascular	☐	Musculoskeletal	☐	Inclusion	Exclusion
Dermatological	☐	Neuropsychiatric (addictions, stress, depression, etc)	☐		
Endocrine	☐	Oncology	☐		
Gastrointestinal	☐	Respiratory/Pulmonary	☐		
Genitourinary	☐	Rheumatologic	☐		
Gynecological	☐	Other	☐		
Head/eyes/ears/nose/throat	☐	Specify:			
Hematological	☐				

D4. Data extraction form (continued)

Number of patients recruited:
Note: Add as many columns as study groups

Total enrolled (or randomized, if applicable):	Group 1:
	Group 2:
Total analyzed:	Group 1
	Group 2
Losses to follow up:	Group 1
	Group 2

Characteristics of participants: *Note: Add as many columns as study groups*

	GROUP 1 (n =)		GROUP 2 (n =)		TOTAL (N =)	
Gender	Female n =	Male n =	Female n =	Male n =	Female n =	Male n =
Age	Mean =	SD =	Mean =	SD =	Mean =	SD =
Ethnicity (n)						
Education (n)						
Principal health problem, condition or diagnosis (n)						
Stage/severity of problem/illness (n)						
Duration of disease described (time)						
Comorbidities/other health problem/s (if relevant) (specify) (n)						
Other relevant social/demographic info						
Cointerventions						

Intervention characteristics: *Note: Add as many columns as study groups*

	Intervention (Group 1)	Control (Group 2)
Name		
Description of intervention		
Frequency (how many times per week/day?)		
Duration (total time = # sessions x length of time in min)		
Intensity (time per session)		
Details of the trainers (a) W*ho delivered the intervention?; b) number of providers; c) training of providers*		
Details of the trainees		
Co-interventions (list)		

Outcomes

Outcome characteristics

Outcome	Instrument/units	Timing of outcome assessment		
		< 3 months	3 to 6 months	> 6 months
1.		☐	☐	☐
2.		☐	☐	☐
3.		☐	☐	☐
4.		☐	☐	☐
5.		☐	☐	☐
6.		☐	☐	☐
7.		☐	☐	☐
8.		☐	☐	☐
9.		☐	☐	☐
10.		☐	☐	☐

Results

For continuous outcomes

Note: Add as many columns as study groups

Outcome	Intervention (Group 1)				Control (Group 2)			
	Baseline		Final		Baseline		Final	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

D4. Data extraction form (continued)

For categorical outcomes
Note: Add as many columns as study groups

Outcome	Intervention (Group 1)		Control (Group 2)	
	Final		Final	
	n	N	n	N
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

n = # events; N = total # subjects per group

D5. Guidelines for data extraction

GENERAL GUIDELINES:

- Please, do not leave empty spaces. Enter either **NA** (not applicable) or **NR** (not reported), as required.
- Double check with a senior member of the research team if you have any doubts about the correct data that should be extracted.

1. GENERAL INFORMATION

1. Data extracted by:
- Choose your name from the available list.

2. Data verified by:
- Complete this field ONLY if you are doing data verification. You do not have to answer this question if you are doing data extraction.
- Choose your name from the available list.

3. Country:
- Enter country where the study took place.
- If not reported, enter **NR** (not reported).

Note*: If the article does not specify in the background/method sections where the study took place, enter the corresponding author's country (and specify this in brackets:* ***"CAC")***.

4. Study source:
- **Abstract:** The study is reported only in abstract form.
- **Journal article:** The study is published as full text in a journal.
- **Conference proceeding:** The study comes from a conference book.
- **Other, specify:** Click here if the study is reported in any other form. Describe the source (book chapter, web-info).

5. Source of funding:
- Check all that apply if more than one option is applicable. Check "None reported" if no source of funding is reported.
- If the source of funding is "academic/from university", report it under "Other" and specify as "Academic".

2. SPECIFIC INFORMATION

Study characteristics

6. Population source:
- It refers to where the study population comes from.
- Check all that applies if more than one population source is cited in the study (i.e. cases from hospitals, controls from community).

7. Number of centres:
- Single centre: If study was conducted in ONE centre.
- Multicentre: If the study was conducted in MORE THAN ONE centre.
- Unclear/not reported: If no information is provided regarding the number of centres, or if it is hard to identify how many centres participated in the study.
- For studies other than RCTs and NRCTs, a multicenter study is a study where more than one source of population is used: For example: cases come from more than one facility/hospital, and controls come from more than one community. Therefore, a single center study collects cases from ONE hospital/facility, and controls from ONE community.

8. <u>Study design:</u>

- **RCT:** A planned experiment or research study in which subjects are allocated to intervention or control groups using a random method, and between-group comparisons are made for the outcomes of interest.
- **NRCT:** Subjects are allocated to intervention or control groups using a quasi-random or nonrandom method and the outcomes are compared.
- **Prospective cohort study with concurrent control group:** A type of analytical observational study where a group of subjects with a specific characteristic or exposure (e.g., being meditators) are followed over a period of time to assess outcomes. Comparisons are made with a concurrent control group. No interventions are normally applied to the participants. It is important to note that: 1) They are longitudinal and go forward over time, 2) Compare exposed vs. nonexposed persons, 3) Start with a defined group of people (defined by exposure). 4) Participants are followed through time for occurrence of disease/outcome of interest.
- **Prospective cohort study with historical control group:** A type of analytical observational study where a group of subjects with a specific characteristic or exposure (e.g., being meditators) are followed over a period of time to assess outcomes. Comparisons are made with a historical control group (e.g. nonmeditators). **Retrospective cohort study with control group (any type):** A type of observational investigation in which medical/other records of groups of individuals who are alike in many ways but differ by a certain characteristic (for example, exposure status to meditation) are compared for a particular outcome. Also called a historic cohort study.
- **Case-control study:** A case-control study is an observational investigation in which people with a condition ("cases") are identified, suitable comparison subjects ("controls") are identified, and the two groups are compared with respect to prior exposure to certain factors (e.g. meditation). Thus, subjects are sampled by disease status. It is important to note that: 1) They are generally retrospective. 2) Start with disease of interest (cases), 3) Compare people with a condition to people without the the condition, 4) Compare frequency of the exposure of interest between cases and controls.
- **Cross-sectional study with controls:** A study where a group of individuals defined by a certain characteristic of interest (e.g. being meditators) are compared at a single point in time cross-sectionally with a control group without that characteristic (nonmeditators) on certain characteristics/outcomes of interest.
- **Before-and-after study:** A nonexperimental study design where data are collected before and after the intervention is implemented. Participants act as their own controls based on previous baseline data.

9. <u>Design source:</u>

- Reported by authors: The authors clearly report the type of study design (and the designation is correct). Use this category when you agree with what the author's report.
- Classified by reviewer: The reviewer used the criteria in #**8** to classify the study design. Use this category when you disagree with the author's design classification, or when the authors failed to provide a clear statement regarding the study design.
- Unclear: It is hard to identify the study design.

10. <u>Aims of study:</u>

- Enter as reported in the study.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

<u>Population characteristics</u>

11. <u>Target population:</u> Clinical population only: The study population consists ENTIRELY of participants with a clinical condition/disorder.

- Normal population only: The study population consists ENTIRELY of "healthy"/normal participants (e.g. students, community members, and/or people without clinical conditions/disorders).
- Both normal and clinical population: The study combines both participants with a clinical condition/disorder and "healthy"/normal participants.
- Not reported: The study does not provide a description of the participants in terms of the type of population.

12. <u>Type of primary health problem/condition/population</u>:

- Enter the type of health problem/condition/population as reported in the study.
- If the study participants are **normals**, enter the specific type of population, if available (e.g., university students, workers, etc).
- Enter either **NA** (not applicable) or **NR** (not reported), if required.

13. If health problem, specify body system involved:

- Choose the corresponding category of response according to the health problems of the study population.
- Check all that apply if more than one health problem/condition/population is relevant.
- If health problem is “None” (e.g. **normals**), enter this information in the OTHER category and specify “None”.

14. Are the inclusion/exclusion criteria for participation in the study specified?

- **Yes:** The study provides data on the set of inclusion and/or exclusion criteria.
- **No:** The study does not FORMALLY provide data on the set of inclusion and/or exclusion criteria.
- Don’t make assumptions regarding I/E based on the description of characteristics of participants. The study authors must provide a description of the inclusion/exclusion criteria.

15. Specify **INCLUSION** criteria and
16. Specify **EXCLUSION** criteria:

- Enter as reported in the study.
- Enter either **NA** (not applicable) or **NR** (not reported), if required.

Characteristics of participants

General remarks: This section should be adapted according to the design of the study (e.g. cohort, case-control, cross sectional).

- If it is an RCT/NRCT, Group 1 refers to the group receiving the active intervention of interest in the study. Group 2 and the others, refer to the comparators. If it is not clearly stated what intervention is the main intervention of interest in the study, it does not matter what you choose to be Group 1 or Group 2, but it is important to be consistent with reporting throughout the form.
- For all other designs, the groups with the exposure of interest (e.g., being meditators) are Group 1, and the comparators are Group 2, 3 etc.

Specify 'N' values for each group

- Complete for all comparison/intervention groups.
- Ideally, the population characteristics refer to those participants who entered the study (not only completers). Otherwise, enter as reported in the study.
- If it is a before-and-after study (within-subject design), enter data only for Group 1.
- For RCTs/NRCTs: The INTERVENTION group (Group 1) comprises individuals receiving the treatment that the study is aimed to evaluate.

17. Total N:

- Enter the total number of study participants in each group (raw numbers).
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

18. Female N:

- Enter the number of females in each group (raw numbers).
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

19. Male N:

- Enter the number of males in each group (raw numbers).
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

Specify age variables

- If reported by gender, enter: M = xxxx; F = xxxxx; T = xxxxx

20. Age range:

- Enter the age range of study participants in years (per group and total), when reported. Ex: 18 – 65 years.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

21. Mean age:

- Enter the mean age of study participants in years (per group and total), when reported. Ex: 26.3 years.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

22. Median age:

- Enter the median age of study participants in years (per group and total), when reported. Ex: 26.3 years.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

23. Standard deviation:

- Enter the standard deviation of mean age of study participants (per group and total), when reported. Ex: SD = 3.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

24. Standard error of the mean:

- Enter the standard error of the mean age of study participants (per group and total), when reported. Ex: SEM = 3.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

25. Age groups (%) as reported:

- If the ages of study participants are reported according to age groups, describe the distribution of percentages across these age groups (n and % per group and total). Ex: 18 – 35 years: 20% (20/100); 36 – 50: 25% (25/100), and so on.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

Other Characteristics of Participants:

- When reported, enter the distribution of study participants (n and % per group and total) according to other characteristics as described below:
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

26. Ethnicity:

- Enter the distribution of study participants (n and % per group and total) according to ethnicity, if reported.
- Ex: White: 20% (20/100); Black: 25% (25/100), etc.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

27. Education:

- Enter as reported in the study
- Enter the distribution of study participants (n and % per group and total) according to education level, if reported.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

28. Principal health problem, condition or diagnosis:

- Enter as reported in the study.
- Enter the distribution of study participants (n and % per group and total) according to the principal health problem, condition or diagnosis (if more than one).
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

29. Stage/severity of problem/illness:

- Enter as reported in the study
- Enter the distribution of study participants (n and % per group and total) according to stage/severity of the problem, if reported.
- The stage/severity of problem can be also reported as a mean score on a certain scale. In that case, specify measure used to grade the level of severity, if available.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

30. Duration of disease:

- Enter as reported in the study (in years or months)
- Enter the distribution of study participants (n and % per group and total) according to duration of the problem, if reported.
- The duration of the problem/disease can be also reported as a mean value (years or months).
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

31. Comorbidities/other health problems
- Enter as reported in the study.
- Enter the distribution of study participants (n and % per group and total) according to the presence of any co-morbidities or health problems other than the main condition of interest.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

32. Other social/demographic details (eg. literacy or reading level, income, employment status, marital status):
- Enter as reported in the study.
- Specify the social/demographic variable. Enter the distribution of study participants (n and % per group and total) according to this variable.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

Intervention characteristics:

33. Specify the type of intervention:
- Single intervention: When meditation comprises a single set of techniques.
- Composite intervention: When a meditation practice is combined with other techniques (they can be other meditation techniques or other interventions).

34. Is meditation used as a control group for a nonmeditation intervention under study?
- This mainly applies when meditation is not the main focus of the study.
- **YES:** Meditation is used only as a control group for other "active" intervention (other than meditation), or intervention of interest under study.
- If the study compares two different meditation techniques, enter **NO**.

35. Sample size:
- Enter the number of participants (per group and total) that were enrolled in the study, and that completed the study.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

36. Name of the intervention(s)/control:
- Enter the name of the intervention(s)/control as reported in the study.
- If the study is other than RCT/NRCT, describe the intervention that was used to classify participants into Group 1.

37. Description of interventions/control:
- Enter as described in the study protocol/description of procedures.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

38. Frequency:
- Enter how many times per week/day the intervention was practiced.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

39. Duration:
- Enter the total time = #sessions x length of time in minutes
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

40. Intensity (Time per session):
- Enter the duration of each session in minutes, if available.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

41. Trainer details (who delivered intervention; number of providers; training of providers for delivery of intervention):
- Enter as reported in the study.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

42. Trainee details:

- Enter as reported in the study.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

43. Cointerventions:

- List any intervention that was co-administered for any of the groups.
- Enter "None" if no interventions were co-administered.
- Enter either **NA** (not applicable) or **NR** (not reported), as required.

Outcome characteristics (#44 and others)

The following information should be completed for each reported outcome. Enter either **NA** (not applicable) or **NR** (not reported), as required.

- NAME: Name of the outcome, as reported in the study.
- CATEGORY OF OUTCOME: Classify according to:
  1 = Physiological markers (e.g., cardiovascular, respiratory, brain, immune, etc).
  2 = Disease/functional outcomes (any outcome reporting either the incidence of discrete events or scores on questionnaires/ tests other than physiological).
  3 = Health care utilization (e.g., frequency and type of healthcare visits, use of medication, cost-effectiveness data).
  4 = Other outcomes (e.g., outcomes difficult to classify in any of the categories above).

- MEASUREMENT TOOL/UNITS:
  Enter the name of the assessment tool (if scales or questionnaires) that was used to evaluate the outcome. Report the measure units, if applicable.

- METHODS OF ASSESSING OUTCOME MEASURES: Enter
  P = Patient (if the measure is self-rated),
  A = assessor (if the measure is assessed by a second person: clinician, family),
  L = laboratory rated (if the measure is assessed using instruments/lab equipment),
  NR = Not reported.

- VALIDITY and/or RELIABILITY: (Applicable for scales and questionnaires)
  Yes: Validity and/or reliability of measurement tool known or described.
  No: Validity and/or reliability of measurement tool unknown.
  NA = Not applicable.
  NR = Not reported.

Note: *The important issue here is whether the scale properties have been published, not the quality of reporting of these characteristics. If the study reports that a "checklist" was developed for the study purposes, it is likely that the instrument has not been validated. In that case, enter* ***"No".*** *On the other hand, if the study uses for example, a scale that it is likely to have reliability and/or validity data available from other sources (e.g. Beck questionnaire for depression), but the study does not mention this, enter* ***"NR".*** *What is important is to know whether the scale properties have been published, or are known, not the reporting of specific details on validity and reliability.*

- TIMING OF OUTCOME ASSESSMENT/FOLLOWUP MEASURES: Enter
  1 = Short term: outcome is assessed in the period less or equal to 3 months.
  2 = Medium term: outcome is assessed in the period greater than three but equal to 6 months.
  3 = Long-term: outcome is assessed for more than 6 months.
  4 = If timing of outcome assessment is not reported.

Note: *Baseline measures are not included for timing of outcome assessment.*

D6. Structured format for peer reviewer comments

Thank you for agreeing to review the draft of this evidence-based report. We are relying on your expertise to address the questions below and provide insight that will assist us in improving the content and format of the report. This is still in the draft stages and a thorough copy edit will take place before the publication of the final report. Please remember that the information in this manuscript is confidential.

When assessing the report, please consider the following points:

Problem Formulation

- Are the review questions well formulated with specified key components?

Study Identification

- Is there a comprehensive search for relevant data using appropriate resources?
- Are there unbiased explicit searching strategies that are appropriately matched to the research question?

Study Selection

- Are appropriate inclusion and exclusion criteria used to select articles?
- Are selection criteria applied in a manner that limits bias?
- Are efforts made to identify unpublished data, if this is appropriate?
- Are major changes in selection criteria avoided during the review process?
- Are reasons for excluding studies from the report stated?

Appraisal of Studies

- Is the validity of individual studies addressed in a reliable manner?
- Are important parameters (e.g., setting, study population, study design) that could affect study results systematically addressed?

Data Collection

- Is there a minimal amount of missing information regarding outcomes and other variables considered key to interpretation of results?
- Are efforts made to reduce bias in the data collection process?

Data Synthesis

- Are important parameters, such as study designs, considered in the synthesis?
- Are reasonable decisions made concerning whether and how to combine the data?
- Are results sensitive to changes in the way the analysis was done?
- Is precision of results reported?

Discussion

- Are the discussion and conclusions well balanced and adequately supported by the data?
- Are limitations and inconsistencies of studies stated?
- Are limitations of the review process stated?
- Are review finding integrated within the context of relevant indirect evidence?
- Are implications for research discussed
- Are implications for practice discussed?

Conclusions

- Are conclusions supported by the data reviewed?
- Are plausible competing explanations of observed effects addressed?
- Is evidence appropriately interpreted as inconclusive (no evidence of effect) or as showing a particular strategy did not work (evidence of no effect)?

- Are important considerations for decision makers identified, including values and contextual factors that might influence decisions?
- Is a summary of pertinent findings provided?
- Is the writing acceptable?

Please make your review as constructive and detailed as possible in your comments so that we have the opportunity to overcome any serious deficiencies that you find and please also divide your comments into the following categories:

Discretionary Revisions. Recommendations for improvement but which the author can choose to ignore.

Minor Essential Revisions. E.g., missing labels on figures, or the wrong use of a term, which the author can be trusted to correct.

Major Compulsory Revisions. Revisions that the author must respond to before a decision on publication can be reached.

Appendix E. Excluded Studies and Nonobtained Studies

For the questions on the state of research on the therapeutic use of meditation in healthcare (topic II), 1,374 studies were excluded. The reasons for exclusion are as follows: (1) the study was not primary research on meditation (n= 909), (2) the study did not have a control group (n= 280), (3) the study did not report adequately on any measurable data for health related outcomes relevant to the review (n= 170), (4) the study did not examine an adult population (n= 9), and (5) the study sample included less than 10 participants (n= 6).

Excluded: Not Primary Research on Meditation (N = 909)

The following studies were excluded because they were not relevant to the review topic.

1. Abbey SE. Mindfulness based stress reduction for oncology patients. Psychooncology 1999;8(6 Suppl):53.

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Excluded: Outcomes—Inadequate Reporting (N = 170)

The following studies were excluded because data relevant to the outcomes of interest were inadequately reported.

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Excluded: Population—Non-Adult (N = 9)

The following studies were excluded because they did not examine an adult population
.

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Excluded: Population—Sample Size Less Than 10 (N = 6)

The following studies were excluded because the study sample included less than 10 participants
.

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Nonobtained Studies (N = 81)

The following studies were not included in the review due to limitations in our library and retrieval resources.

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Appendix F. References of Multiple Publications (Topics II to V)

From 911 included articles, 108 were identified as multiple publications, that is, cases in which the same study was published more than once, available in another format, or part of data from an original report was republished. The multiple publications were not considered to be unique studies and any information that they provided was included with the data reported in the main study. The report that was published first was regarded as the main study.

1. Ades PA, Savage PD, Cress ME, et al. Resistance training on physical performance in disabled older female cardiac patients. Med Sci Sports 2003;35(8):1265-70. **Associated publication of 233**

2. Alexander CN, Langer EJ, Newman RI, et al. Transcendental Meditation, mindfulness, and longevity: an experimental study with the elderly. J Pers Soc Psychol 1989 ;57(6):950-64. **Associated publication of 279**

3. Alexander CN, Schneider RH, Staggers F, et al. Trial of stress reduction for hypertension in older African Americans II: sex and risk subgroup analysis. Hypertension 1996;28(2):228-37. **Associated publication of 221**

4. Anderson VL. The effects of meditation on teacher perceived occupational stress and trait anxiety [dissertation]. Indiana, PA: Indiana University of Pennsylvania; 1996. **Associated publication of 384**

5. Barnes VA, Treiber FA, Turner JR, et al. Acute effects of Transcendental Meditation on hemodynamic functioning in middle aged adults [abstract]. In: 57th Annual Scientific Conference of the American Psychosomatic Society; Vancouver, BC; 1999. No. 1209. **Associated publication of 385**

6. Blumenthal JA, Emery CF, Madden DJ, et al. Effects of exercise training on cardiorespiratory function in men and women older than 60 years of age. Am J Cardiol 1991;67(7):633-9. **Associated publication of 280**

7. Blumenthal JA, Emery CF, Madden DJ, et al. Cardiovascular and behavioral effects of aerobic exercise training in healthy older men and women. J Gerontol 1989;44(5):147-57. **Associated publication of 280**

8. Blumenthal JA, Emery CF, Madden DJ, et al. Effects of exercise training on bone density in older men and women. J Am Geriatr Soc 1991;39(11):1065-70. **Associated publication of 280**

9. Bowman AJ. Effects of aerobic exercise training and yoga on cardiac and lymphocyte beta-adrenergic responses in sedentary elderly subjects. J Am Geriatr Soc 1995;43(9):SA78. **Associated publication of 281**

10. Carlson LE, Speca M, Patel KD, et al. Mindfulness-based stress reduction in relation to quality of life, mood, symptoms of stress and levels of cortisol, dehydroepiandrosterone sulfate (DHEAS) and melatonin in breast and prostate cancer outpatients. Psychoneuroendocrinology 2004;29(4):448-74. **Associated publication of 386**

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13. Chang JC, Chiung W. Effect of meditation on music performance anxiety [dissertation]. New York: Columbia University; 2001. **Associated publication of 387**

14. Chen KM, Snyder M, Krichbaum K. Tai chi and well-being of Taiwanese commmunity-dwelling elders. Clin Gerontol 2001;24(3-4):137-56. **Associated publication of 388**

15. Cohen L, Thornton B, Chanmdwani K. A randomized trial of a Tibetan yoga intervention for breast cancer patients [abstract]. In: 63rd Annual Scientific Conference of the American Psychosomatic Society; Vancouver, BC; 2005. No. 1607. **Associated publication of 120**

16. Cooper MJ, Aygen MM. A relaxation technique in the management of hypercholesterolemia. J Hum Stress 1979;5(4):24-7. **Associated publication of 291**

17. Cusumano JA. The short-term psychophysiological effects of hatha yoga and progressive relaxation on female Japanese students [dissertation]. Tempe, AZ: Arizona State University; 1991. **Associated publication of 389**

18. Daubenmier JJ. The relationship of yoga, body awareness, and body responsiveness to self objectification and disordered eating. Psychol Women Q 2005;29(2):207-19. **Associated publication of 390**

19. Davis PG, Mustian KM, Katula JA, et al. Tai chi chuan and insulin-like growth factor-I (Igf-I) in breast cancer survivors. Med Sci Sports Exerc 2004;36(5 Suppl):S97-8. **Associated publication of 391**

20. Delmonte MM. Effects of expectancy on physiological responsivity in novice meditators. Biol Psychol 1985;21(2):107-21. **Associated publication of 392**

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27. Gilbert GS, Parker JC, Claiborn CD. Differential mood changes in alcoholics as a function of anxiety management strategies. J Clin Psychol 1978;34(1):229-32. **Associated publication of 265**

28. Goodale IL. The effects of the relaxation response on premenstrual syndrome [abstract]. Diss Abstr Int 1990;50(8B):3731. **Associated publication of 396**

29. Hass CJ, Gregor RJ, Waddell DE, et al. The influence of tai chi training on the center of pressure trajectory during gait initiation in older adults. Arch Phys Med Rehabil 2004;85(10):1593-8. **Associated publication of 397**

30. Irwin MR, Pike JL, Cole JC, et al. 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. **Associated publication of 398**

31. Jevning RA, Wells I, Wilson AF. Plasma thyroid hormones, thyroid stimulating hormone, and insulin during acute hypometabolic states in man. Physiol Behav 1987;40(5):603-6. **Associated publication of 399**

32. Jevning RA, Wilson AF. Acute decline in adrenocortical activity during Transcendental Meditation. In: Chalmers RA, Clements G, Schenkluhn H, et al., eds. Scientific research on Maharishi's Transcendental Meditation and TM-Sidhi programme: collected papers. Vol. 2. Switzerland: Maharishi European Research University - MVU Press; 1990. p. 811. **Associated publication of 400**

33. Jevning RA, Wilson AF, Davidson JM. Adrenocortical activity during meditation. Horm Behav 1978;10(1):54-60. **Associated publication of 400**

34. Jevning RA, Wilson AF, Pirkle HC. Modulation of red cell metabolism by states of decreased activation: comparison between states. Physiol Behav 1985;35(5):679-82. **Associated publication of 399**

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Appendix G. Summary Tables for Topic II

Table G1. Country of study

	Country	N	References
North America	United States	462	111,120,126,152,175,177,193,205,206,208,233,234,258-260,279,280,289,290,304,311,384,385,387,394,436-494a494b127,171,197,306,495-508a306b192,509b509a80,94,134,186,187,237,282,292,324,390,510-547a547b548-552a552b209,396,402,553-571b571a178,195,210,271,398-401,403,572-624a624b70,75,78,91,92,105,118,141,168,174,181,188,190,191,196,198,202,220,221,227,228,241,242,244-246,251,252,263-265,267-270,272,274,284,285,287,288,293,309,316,317,319,322,325,391,397,406-410,412,414,416,418-425,433-435,625-769
	Canada	32	97,182,189,194,296,386,395,413,770-793
Asia	India	115	83,133,137,138,140,142,170,172,184,204,212,217,226,239,240,250,266,273,278,294,295,298,300,301,303,305,310,312-314,318,320,321,323,404,411,415,417,794-870
	China	19	161,211,225,249,262,871-884
	South Korea	15	200,201,213,214,405,885-894
	Hong Kong	13	207,286,299,895-904
	Taiwan	12	223,248,326,388,432,905-911
	Japan	10	389,426,912-919
	Thailand	5	106,216,238,920,921
	Malaysia	2	179,180
Europe	United Kingdom	31	122,167,185,218,219,235,281,283,308,427,431,922-941
	Germany	12	215,247,942-950a950b
	Sweden	9	951a951b243,261,302,952-955
	Norway	7	956-962
	Ireland	5	392,393,963-965
	Italy	4	966-969
	Switzerland	4	199,970-972
	Netherlands	4	973a973b224,974
	Spain	3	975-977
	Austria	2	430,978
	Czech Republic	2	183,979
	France	2	980,981
	Russia	2	146,203
	Turkey	2	315,982

Table G1. Country of study (continued)

Country		N	References
Europe (continued)	Denmark	1	983
	Poland	1	984
	Belgium	1	985
Australasia	Australia	20	169,297,307,428,986-1001
	New Zealand	6	222,429,1002-1005
Other	Israel	4	176,291,1006,1007
	South Africa	3	86,1008,1009
	Brazil	2	236,1010
	Argentina	1	1011
	Netherlands Antilles	1	974

Table G2. Study design

	Study design	N	References
Intervention studies	RCTs	286	86,111,120,176,177,189,193,203-208,233-235,258-261,278-281,304,305,384,387,394,437,444,445,447,448,455,460,467,472,474-478,480,483-485,490,493,494,796,871,885,895b127,194,236,306,389,503,504,507a70,75,78,91,92,94,97,118,134,138,140,167-170,174,182,184-186,190-192,195,196,209-225,237-246,262-270,282-288,307-309,325,386,391,392,395-398,403-405,407-409,413,417,418,421,423,424,427,431,433,434,512,514,515,519,521,528,530,531,536,537,539,541-545,549,554,556-558,562,567,569,572,573,575,579,584,589,592,594,597,603,610,615,616,618,625-627,631,637,651,658,665,666,674,676,677,680,683,687,702,706,710,711,714,719,726,736,738,746,751,754-756,759,761,764,765,767-769,774,775,777,782,783,791,793,805,811,819,823,825,829,832,836-839,841,844,852,858,868,882,894,900,910,919,920,926,929,930,932,934,940,943,945,946,953,954,956,959,961,965,971,977,984,987,988,991,998,999,1005,1006,1011
	NRCTs	114	126,175,289,290,440,461-463,482,489,494,794,799a197,291,306,500b106,122,137,178-181,183,187,188,198,199,226-228,247-252,271-274,292,293,326,415,419,420,429,430,435,518,523,532,538,553,566,577,587,593,595,596,602,617,629,639,642,645,650,656,659,662,673,678,679,681,689,691,696,698,705,713,728,730,752,758,762,773,787,789,804,806,809,816,818,824,826,834,846,854,860,864,866,878,904,915,925,938,955,974,981,986,1001,1007
	Before-and-after	147	Controlled (2) [171,172] Uncontrolled (145) [83,133,152,294-303,310-324,393,402,406,411,414,425,426,442,457,459,464,468,471,488,491,502,505,510,516,517,524,525,533,559,561,564,578,580,588,590,604,606,608,609,611,613,620-623,634,635,652-654,657,682,684,690,692,697,707,709,715,716,724,725,727,733,739,747,750,753,766,770,780,784,797,800-802,808,810,812-815,821,822,827,830,831,840,843,845,847,848,850,851,856,862,863,867,870,872,875,883,889,891,897,906,913,914,916,922,931,942,944,947,962,963,966,979,982,992,996,1002]
Observational analytical studies	Cohort studies with controls	149	400,422,439,450,452,453,487,492,600,601,624,669,771,776,873,949,970a624b80,105,141,142,161,200-202,385,399,401,416,428,436,449,456,458,466,469,479,486,498,499,501,508,520,522,526,527,540,548,550,555,563,574,576,581,583,585,586,598,599,605,607,612,614,619,630,633,643,644,647,655,663,668,670,672,675,685,686,688,693,695,699,700,703,708,712,720,721,723,772,779,781,788,790,803,807,817,820,833,835,853,855,857,861,874,877,886,907,909,912,917,921,923,927,928,935,948,950,952,958,960,964,967,969,972,983,985,989,994,995,997,1008,1009a950b731,734,936,973a973b741,745,749,755,757,760,763,792,939,1003
	Cross-sectional studies with controls	117	412,509,529,546,582,591,704,732,740,748,786b571b441,534,535,551,646,649,701,722,737,743,744,859,937,941,951,957,975,976a951b552a552b513,547,795,828a547b438,446,451,568,570,571,640,660,661,694,717,978,980,993,1004a509,560,638,648,671,718,1000a146,388,390,432,443,454,465,470,473,481,495-497,506,511,565,628,632,636,641,664,667,729,735,742,778,785,798,842,849,865,869,876,879-881,884,887,888,890,892,893,896,898,899,901-903,905,908,911,918,924,933,968,990,1010

Table G3. Publication type

Type of publication	N	References
Journal article	701	120,146,176,177,189,193,203,204,206-208,233-235,258,259,261,278-281,289,290,295,297,304,305,310-312,384,385,387,394,436-440,445-452,454,456-466,468,470-473,475-481,483-486,488,489,491-494,770,771,794-802,871,885,895,922,952,966,978,980,1010a494b127,171,194,236,291,306,389,495,498-503,505,507,508,1008a306b192,294,509,982b509a80,187,282,324,392,393,395,510-513,515,516,518-531,533-540,542-547,772,803-808,921,923,942,963-965,967,986,987,1009a547b185,209,396,402,548-551,553-555,557-566,568,570,571,774,775,809-811,924,988b571a138,178,195,211,212,238,248,271,283,296,298,299,307,313-315,326,398-401,404,572-580,582,583,585,586,588,590,592,594,595,597-599,601,603-613,615-624,776,777,812-821,873,874,886,896,905-908,912-916,926-928,945,946,970,975,976,989,1006a624b92,97,161,168,172,179-182,184,188,190,198,200-202,213,214,216-222,226,239,240,262,264-269,272,284,288,300-302,308,309,316,318-320,405-411,413-420,422,426,625-629,631-634,636-655,657-663,665,666,668-678,680-686,688-694,697-699,701,702,704-706,778-782,785-788,822-844,876,877,887-893,897-899,909,917,929-932,947-949,953,956,972,974,977,979,991-995,1002,1007,174,707,708,709,710,711,845,137,846,847,712,996,714,715,918,716,997,321,848,789,717,424,718,719,957,958,959,960,961,894,790,791,386,849,142,183,985,721,243,933,983,227,722,850,273,106,723,285,851,934,228,935,724,244,425,725,998,852,726,270,427,428,853,83,854,133,855,856,857,858,140,859,323,860,861,286,429,969,728,729,70,950a,950b,293,731,732,733,734,223,249,910,900,901,878,879,880,902,735,936,862,863,962,170,937,973a,973b,224,864,325,865,303,866,981,867,868,869,739,431,740,741,742,743,744,745,746,432,747,748,749,750,751,752,753,754,954,755,938,939,955,1000,940,756,118,1003,1004,757,941,758,759,760,761,434,397,792,911,274,122,763,764,765,766,881,767,903,1001,870,768,435,246,225,904,250,287,251,793,191,252,199,884,1005,984,769
Thesis/Dissertation	79	951a951b86,111,126,134,152,175,197,205,237,260,292,388,390,442-444,453,455,469,474,482,487,490,496,497,504,506,514,517,532,541,552,773,920a552b75,78,91,105,141,196,210,241,263,391,412,421,423,433,567,569,581,584,589,591,593,602,614,630,635,656,664,667,679,687,695,696,703,727,736-738,762,784,882,971,990
Abstract	25	94,215,242,245,247,317,322,403,430,467,556,587,596,600,700,713,720,730,872,875,883,943,944,999,1011
Unpublished	3	167,169,783
Research letter	3	919,925,968
Book chapter	2	186,441

Table G4. Methodological quality—intervention studies

RCTs—Jadad scale	RCTs that obtained Jadad scores lower than 3 (n = 246) [111,176,177,203,204,233,259-261,278-281,304,305,384,394,437,444,445,447,448,455,460,467,472,474-478,480,796 186,189,192-194,205-208,235,236,306,387,389,392,483-485,490,493,494,503,507,512,514,515,519,805,871,895,920,965,987 94,134,185,209,237,395,396,528,530,531,536,537,539,543,545,549,554,556-558,562,567,569,572,573,575,774,775,811,943,988,1006,1011 138,195,210-214,238,262,283,307,403-405,408,584,594,597,603,610,615,616,618,625-627,777,819,926,945,946,971 92,97,215-219,239,240,263,264,308,407,410,413,417,433,637,651,658,665,666,674,676,782,823,825,829,929,930,953,956,977 70,78,118,140,170,182,184,190,191,196,222-225,241-246,267-270,285,286,288,309,325,397,418,423,427,431,434,677,680,683,687,702,706,710,711,714,719,726,736,746,751,754,756,759,761,764,765,767-769,791,793,832,836-838,841,844,852,858,868,882,900,910,919,932,934,940,954,959,961,984,998,1005]
	RCTs that obtained Jadad scores greater than 3 (n = 40) [75,86,91,120,127,167-169,174,220,221,234,258,265,266,282,284,391,398,409,421,504,521,541,542,544,579,589,592,631,783,839,885,991 287,386,424,738,894,999]
	RCTs describing the methods of randomization (n = 60) Appropriate (n = 45) [86,120,127,167,206,234,258,260,282,398,448,504,521,541,542,544,569,573,579,589,592,631,811,885 91,265,266,284,308,391,409,421,783,825 75,168,174,220,221,287,386,738,839,894,910] Inappropriate (n = 15) [134,212,213,262,404,408,478,484,545,584,761,841,868,920,971]
	RCTs described as double-blind (n = 8) [167-170,424,782,991,999]
	RCTs describing withdrawals/dropouts (n = 145) [86,111,120,189,193,203,207,234,258,278-281,394,444,455,467,478,480,484,485,494,885,895b75,78,91,92,94,97,127,167-169,174,185,196,210,213,214,216,218-224,236,238,241,243,244,246,263-266,282-287,325,386,391,395,398,408-410,421,423,434,503,504,507,514,515,521,528,536,537,541,542,544,556,557,562,575,579,584,589,592,603,610,616,618,626,627,631,637,651,666,683,702,710,711,714,726,738,754,759,764,765,767-769,777,783,791,793,829,839,841,852,868,882,894,920,926,929,930,940,945,946,953,954,971,977,984,991,998,999]
RCTs—Concealment of treatment allocation	RCTs with adequate report of methods for concealment of allocation (n = 12) [168,169,246,418,476,521,544,589,631,894,926,991]
	RCTs with inadequate report of methods for concealment of allocation (n = 2) [545,868]
	RCTs that failed to describe the methods for concealment of allocation (n = 272) [86,111,176,177,203,204,233,258-261,278-281,304,305,384,394,437,444,445,447,448,455,460,467,472,474,475,477,478,796 120,189,193,205-208,234,235,387,480,483-485,490,493,494,871,885,895b127,194,236,306,389,503,504,507a192,512,514,515,805 94,134,185,186,237,282,392,395,396,519,528,530,531,536,537,539,541-543,549,554,556-558,562,774,775,920,943,965,987,988,1011 138,167,195,209-211,238,283,307,398,403,567,569,572,573,575,579,584,592,594,597,603,610,615,616,618,777,811,819,945,946,971,1006 91,92,212-216,239,240,262,308,404,405,407-410,413,421,433,625-627,637,782,783,823,825,929,930,953,977 97,190,217-219,241,242,263-267,284,288,309,391,417,651,658,665,666,674,676,677,680,683,829,832,836-839,956 75,174,182,184,220-222,243,244,268-270,285,386,423,424,687,702,706,710,711,714,719,726,791,841,844,852,932,934,959,961,998 70,78,118,140,170,191,196,223-225,245,286,287,325,397,427,431,434,736,738,746,751,754,756,759,761,764,765,767-769,793,858,882,900,910,919,940,954,984,999,1005]
RCTs - Funding	Funding reported (n = (118) [120,189,193,205-208,233,234,279,280,394,444,448,460,474,475,478,480,485,494,871,895b194,306,503,507a94,97,118,167,168,174,185,192,195,209,214,218-222,224,225,239,240,243,246,264,268-270,282,284,288,386,395,397,398,403,405,407-410,413,421,423,427,433,512,521,536,537,544,545,557,562,573,575,579,592,610,618,625,626,631,637,651,665,683,710,726,746,754,764,767-769,774,777,783,793,825,839,852,868,894,900,930,934,940,953,954,961,991,999]
NRCTs—Jadad scale	NRCTs describing withdrawals/dropouts (n = 52) [126,175,289,290,440,461,462,482,494a197,291,292,518,532,553,577,593,773,809,925 122,228,248-252,271,293,326,419,420,435,602,617,642,645,650,679,681,691,728,762,787,816,846,866,878,904,938,955,1007]

NRCT = nonrandomized controlled trials; RCT = randomized controlled trials

Table G4. Methodological quality—intervention studies (continued)

Before-and-after studies	Before-and-after studies with study population representative of the target population (n = 23) [294,414,425,464,502,564,590,604,606,609,613,621-623,682,692,697,716,724,808,810,847,962]
	Before-and-after studies in which the method of outcome assessment was the same for the pre- and post-intervention periods for all participants (n = 140) [83,133,152,171,172,294-298,300-303,310,312-324,393,402,406,411,414,425,426,442,459,464,468,471,488,491,502,505,510,516,517,524,525,533,559,561,564,578,580,588,590,604,606,608,609,613,620-623,634,635,652-654,657,682,684,690,692,707,709,715,716,724,725,727,733,739,747,750,753,766,770,780,784,797,800-802,808,810,812-815,821,822,827,830,831,840,843,845,847,848,850,851,856,862,863,867,870,872,875,883,889,891,897,906,913,914,922,931,942,944,947,962,963,979,982,992,996,1002]
	Before-and-after studies in which outcome assessors were blind to intervention and assessment period (n = 3) [654,753,962]
	Before-and-after studies that reported the number of study withdrawals (n = 45) [295,296,402,406,411,414,425,442,457,471,488,502,525,533,559,561,564,604,609,611,613,620-623,635,684,690,709,716,725,727,733,739,753,770,784,797,801,814,851,897,922,942,996]
	Before-and-after studies that reported the reasons for study withdrawal (n = 20) [411,442,471,502,525,559,561,564,609,613,623,635,684,690,725,727,733,739,801,897]
	Before-and-after studies that reported source of funding (n = 41) [133,294,296-303,402,406,411,459,488,502,516,533,559,606,613,621,623,634,684,697,753,766,770,800,822,830,831,843,848,850,862,863,883,889,944]

Table G5. Methodological quality—observational analytical studies

Cohort studies—NOS scale	Cohort studies describing representative samples of the target population (n = 55) [80,439,449,453,456,466,469,479,487,492,501,520,522,548,550,555,563,605,607,612,619,624,776,803,874,921,970a624b142,161,422,428,655,669,675,695,708,835,855,861,877,935,949,950,958,969,972,994,997a950b973a741,755,760,792]
	Cohort studies describing nonexposed cohorts drawn from the same community as the exposed cohort (n = 56) [80,400,401,436,439,449,453,458,466,486,520,522,527,540,548,563,599,605,614,624,772,807,873,874,907,912,921a624b142,416,663,668,670,685,693,695,699,703,708,712,781,788,790,857,877,935,950,958,969a950b973a741,749,755,757,1003]
	Cohort studies that reported reliable methods for ascertainment of exposure (n = 10) [141,439,456,458,668,776,835,949,969,973a]
	Cohort studies that reported reliable methods for ascertainment of outcome (n = 10) [80,453,466,469,605,619,630,695,958,1009]
	Cohort studies that adjusted for important confounding factors in the design or analysis (n = 99) [105,142,200,201,385,399-401,422,449,466,486,492,501,522,555,574,583,585,598,599,607,612,668,669,672,675,685,693,703,723,772,779,803,833,853,873,909,923,949,950,964,972,983,997a950b936,973a141,416,439,453,458,487,498,520,526,563,576,581,644,647,695,700,712,720,731,734,741,745,749,755,757,763,776,792,807,817,835,855,857,861,874,877,886,907,921,939,948,958,960,967,969,985,989,995,1003,1008,1009]
	Cohort studies that reported reliable methods for outcome assessment (n = 109) [80,161,200-202,385,399-401,416,428,439,449,450,452,456,458,466,479,486,498,499,501,508,520,526,540,555,576,581,585,586,598-601,612,619,633,643,644,647,655,668,669,672,675,685,686,693,699,700,703,712,720,721,723,731,734,741,745,749,755,757,760,763,771,772,776,779,781,792,803,807,817,833,853,855,857,861,874,877,886,907,909,912,917,923,927,928,939,948,949,952,958,960,964,967,969,970,972,983,985,989,995,997,1003,1008,1009]
	Cohort studies reporting length of followup enough for outcomes to occur (n = 44) [439,453,456,469,487,492,501,522,548,563,574,583,599,605,614,619,624,776,820,873,874a624b105,141,142,422,630,663,669,670,688,695,708,833,855,861,877,949,950,969,994a950b936,973a]
	Cohort studies reporting adequate followup of cohorts (n = 29) [141,439,469,487,501,522,548,599,605,614,619,630,669,670,708,855,857,861,873,874,877,921,949,950,969,994a950b936,973a]
	Cohort studies that reported source of funding (n = 41) [161,200,201,385,399,416,422,439,453,456,486,492,498,555,585,605,607,644,734,745,755,757,760,776,788,792,807,833,874,877,886,909,912,949,960,967,989,997,1003,1008,1009]
Cross sectional studies—NOS scale	Cross sectional studies describing representative samples of the target population (n = 62) [951a951b388,441,443,446,454,470,473,481,495-497,506,529,534,535,551,552,978a552b432,560,565,568,570,582,591,628,632,646,648,649,660,661,701,717,729,740,744,748,778,865,869,876,879,880,887,888,890,892,896,899,901,902,905,908,924,933,941,976,990]
	Cross sectional studies describing that comparison groups were drawn from the same community as the study group (n = 24) [951a951b388,390,441,446,454,481,497,570,582,591,628,646,648,660,701,722,737,740,778,849,899,924]
	Cross sectional studies that reported reliable methods for ascertainment of exposure (n = 0)
	Cross sectional studies that adjusted for important confounding factors in the design or analysis (n = 63) [146,951a951b388,390,438,441,443,446,470,473,495-497,506,511,529,546,551,552,795,798,980a552b412,560,568,570,591,638,640,641,646,661,664,667,701,717,722,732,735,740,743,744,748,778,849,865,876,880,884,887,888,890,892,899,901,905,911,924,933,976,990]
	Cross sectional studies that reported reliable methods for outcome assessment (n = 62) [146,451,465,509,798,978,980,1010a513,551,552a552b432,565,632,636,640,641,646,648,664,667,694,701,717,718,729,732,735,737,740,743,744,842,859,869,876,879-881,884,892,893,896,898,899,901-903,905,908,911,918,937,941,957,968,975,976,990,1000,1004]
	Cross sectional studies that reported source of funding (n = 27) [388,432,438,473,511,632,636,641,646,649,704,744,778,798,876,879,880,888,893,896,901-903,905,908,957,1010]

NOS = Newcastle-Ottawa scales

Table G6. Studies on meditation practices examined in clinical trials and observational studies

Category of meditation practice	Meditation practice	N	Study design and associated references
Mantra meditation (337)	ACEM meditation	7	RCT (3);[956,959,961] Cohort (3);[720,958,960] Cross sectional (1)[957]
	Ananda marga	3	Cohort (2);[498,526] Cross sectional (1)[786]
	Cayce's meditation	1	RCT (1) [680]
	CSM	11	RCT (11) [97,193,264,384,410,536,537,627,658,676,702]
	SRELAX (technique modeled after TM®	1	RCT (1) [222]
	Concentrative/ rosary prayer	2	Before-and-after (1); [966] Cohort (1) [969]
	Mantra meditation	31	RCT (17);[194,203,260,434,472,483,503,531,597,626,706,719,736,761,777,805,965] NRCT (3);[494,577,650a] Before-and-after (6);[393,652-654,856,963] Cohort (1);[853] Cross sectional (4); [591,828,859,937]
	RR	51	RCT (40);[208,234,236,304,306,394,460,475-477,480,504a75,91,92,94,191,192,209,218,265,268,283,284,288,396,515,521,530,558,567,569,572,592,594,610,616,625,637,988] NRCT (5);[306b228,673,678,938] Before-and-after (5);[414,459,524,525,753] Cohort (1)[492]
	TM®	230	RCT (38);[86,186,189,190,205,206,210,220,221,259,261,267,279,282,309,392,407,418,433,478,519,528,545,557,674,677,683,782,796,945 78,270,424,714,759,769,793,1005] NRCT (22); [187,188,271,289,291,292,429,440,463,518,538,587,659,662,705,787,816,974,986,293,758,252] Before-and-after (19); [171,295,311,319,324,471,505,533,561,709,733,750,780,814,815,850,942,996,1002] Cohort (97); [80,385,399-401,436,439,449,450,452,453,458,466,469,487,499,501,508,520,522,540,548,555,563,576,581,583,585,586,598-601,607,612,619,624,771,772,776,817,923,927,928,952,964,970,1008a624b416,422,428,633,643,644,647,655,663,668-670,672,675,685,686,688,693,695,700,703,712,721,723,779,781,790,835,950,972,983,994,997a950b731,734,936,973a973b741,745,749,757,760,763,792,939,1003] Cross sectional (54) [951a951b438,441,446,451,509,795,978,980a509b513,529,534,535,546,547a547b551,552a552b560,568,570,571a571b412,582,638,640,646,648,649,660,661,671,694,701,704,717,718,722,732,737,740,743,744,748,941,975,976,993,1000,1004]
Mindfulness meditation (127)	MBSR	49	RCT (22);[167,195,196,244,245,263,421,423,485,493,512,556,575,579,589,687,710,711,754,756,930,934;] NRCT (11) [272,419,420,482,593,602,681,689,691,752,773] Before-and-after (16) [402,457,488,517,606,609,620,622,635,682,684,692,697,724,770,947]

CSM = Clinically Standardized Meditation; MBCT = mindfulness-based cognitive therapy; MM = mindfulness meditation; ND = not described; NS = not specified; RR = Relaxation Response; TM® = Transcendental Meditation®

Table G6. Studies on on meditation practices examined in clinical trials and observational studies (continued)

Category of meditation practice	Meditation practice	N	Study design and associated references
Mindfulness meditation (continued)	MM (NS)	37	RCT (16);[241,242,258,386,395,403,444,447,448,474,490,738,751,775,932,1011] NRCT (8);[106,249,430,523,532,696,728,762] Before-and-after (6);[442,464,604,716,727,922] Cohort (4);[479,486,605,614] Cross sectional (3)[497,511,641]
	Zen Buddhist meditation	28	RCT (7); [70,225,237,554,765,774,920] NRCT (5);[197,227,500,629,639] Cohort (6);[105,456,550,886,917,995] Cross sectional (7);[443,495,636,729,742,918,924] Before-and-after (3) [426,913,916]
	MBCT	7	RCT (5);[427,455,929,940,984] NRCT (1);[553] Before-and-after (1)[784]
	Vipassana	6	Before-and-after (2) [847,848;] Cohort (2) [708,921;] Cross sectional (2) [664,990]
Meditation practices (ND)		21	RCT (11);[387,484,494b215,431,514,539,651,783,910,987] NRCT (6);[198,199,274,656,730,915] Before-and-after (2);[580,808] Cohort (1);[630] Cross sectional (1)[481]
Miscellaneous meditation practices		11	RCT (3);[507,726,791] Before-and-after (3);[621,623,801] Cohort (2);[935,967] Cross sectional (3)[454,628,933]
Qi Gong		37	RCT (13);[207,211,213,214,243,262,405,767,900,919,953,954,977] Before-and-after (9);[299,316,502,634,875,889,891,914,944] Cohort (7); [161,200-202,873,907,912] Cross sectional (8);[632,778,884,887,888,890,892,893]
Tai Chi		88	RCT (29);[235,285,286,307,391,398,408,409,413,437,467,541,573,603,631,665,871,885,894,895,1006,223,999,746,397,882,768,246,287] NRCT(17);[248,290,326,435,489,566,595,596,617,645,698,713,789,878,904,955,1001] Before-and-after (20);[152,296,317,425,564,588,590,608,657,690,715,725,747,766,872,883,897,906,931,962] Cohort (4);[699,874,877,909] Cross sectional (18) [388,432,470,565,735,876,879-881,896,898,899,901-903,905,908,911]
Yoga		192	RCT (69);[111,118,120,127,134,138,140,168-170,174,176,177,182,184,185,204,212,216,217,219,224,233,238-240,266,269,278,280,281,305,308,325,389,404,417,445,542-544,549,562,584,615,618,666,764,811,819,823,825,829,832,836-839,841,844,852,858,868,926,943,946,971,991,998] NRCT (36);[122,126,137,175,178-181,183,226,247,250,251,273,415,461,462,642,679,794,799,804,806,809,818,824,826,834,846,854,860,864,866,925,981,1007] Before-and-after (54);[83,133,172,294,297,298,300-303,310,312-315,318,320-323,406,411,468,491,510,516,559,578,611,613,707,739,797,800,802,810,812,813,821,822,827,830,831,840,843,845,851,862,863,867,870,979,982,992] Cohort (18);[141,142,527,574,755,788,803,807,820,833,855,857,861,948,949,985,989,1009] Cross-sectional (15) [146,390,465,473,496,506,667,785,798,842,849,865,869,968,1010]

Table G7. Type of control groups for intervention studies on meditation practices

Type of control group	N groups	N studies	References
Placebo/sham	18	18	Mantra meditation (9 groups, 9 studies) TM® (3);[433 793,1005] Mantra (NS) (3);[434,472,531] RR (2);[477,678] SRELAX (1)[222] Meditation practices (ND) (3 groups, 3 studies) [484,651,987] Yoga (2 groups, 2 studies) [170,846] Mindfulness meditation (1 group, 1 study) Zen Buddhist meditation (1) [554] Qi Gong (2 groups, 2 studies) [405,767] Tai Chi (1 group, 1 study) [999]
No-treatment concurrent controls: NT	126	123	Mantra meditation (44 groups, 43 studies) TM® (25);[86,171,187,188,190,259,279,282,291-293,440,463,518,538,662,674,705,758,769,793,945,974,986,1005] Mantra (NS) (8);[194,203,434,472,531,597,650,719] RR (6);[92,192,284,394,480,673] CSM (2);[264,676] ACEM meditation (1);[959] Cayce's meditation (1)[680] Yoga (31 groups, 30 studies) [111,126,137,168,172,175,185,204,217,247,251,305,325,417,445,542,679,799,804,806,819,823,826,838,854,860,864,925,943,981] Mindfulness meditation (23 groups, 22 studies) MBSR (9);[167,244,245,272,419,575,593,691,930] MM (NS) (7);[106,395,474,523,728,762,1011] Zen Buddhist meditation (5);[70,225,554,629,920] MBCT (1) [455] Tai Chi (19 groups, 19 studies) [223,285,286,290,326,437,467,489,541,595,596,617,645,698,882,885,894,895,955] Meditation practices (ND) (6 groups, 6 studies) [215,431,656,730,915,987] Qi Gong (2 groups, 2 studies) [262,954] Miscellaneous meditation practices (1 group, 1 study) [791]
No-treatment concurrent controls: WL	62	62	Mantra meditation (24 groups, 24 studies) TM® (10); [86,252,259,271,289,309,418,528,557,677] CSM (5);[193,384,536,537,658] RR (5); [75,208,476,515,610] Mantra (NS) (3); [626,761,805] SRELAX (1) [222] Mindfulness meditation (21 groups, 21 studies) MBSR (11);[420,421,485,493,512,589,602,681,710,711 196] MM (NS) (6);[386,395,403,430,447,532] MBCT (2); [553,984] Zen Buddhist meditation (2) [765,774] Yoga (10 groups, 10 studies) [120,169,175,280,584,666,764,825,946,971] Meditation practices (ND) (3 groups, 3 studies) [387,730,783] Qi Gong (2 groups, 2 studies) [213,214] Tai Chi (2 groups, 2 studies) [398,408]

BF = Biofeedback; CSM = Clinically Standardized Meditation; MBCT = mindfulness-based cognitive therapy; MBSR = Mindfulness-based stress reduction; MM = mindfulness meditation; = ND = not described; NS = not specified; NT = no treatment; PMR = progressive muscle relaxation; RR = Relaxation Response; TM® = Transcendental Meditation®; WL = waiting list

Table G7. Type of control groups for intervention studies on meditation practices (continued)

Type of control group		N groups	N studies	References
Active (positive) concurrent controls—interventions other than meditation practices	Exercise/physical activity	52	45	Yoga (23 groups, 18 studies) [233,266,280,281,415,417,461,462,618,666,811,834,836,837,839,844,998,1007] Tai Chi (14 groups, 14 studies) [235,248,287,307,409,413,435,541,603,631,665,713,789,1006] Mantra meditation (13 groups, 10 studies) Mantra (NS) (3); [483,706,777] RR (3); [304,394,480] TM® (2); [78,282] ACEM meditation (1); [956] CSM (1) [264] Mindfulness meditation (1 group, 1 study) MBSR (1) [930] Meditation practices (ND) (1 group, 1 study) [514] Qi Gong (1 group, 1 study) [207]
	Rest and states of relaxation	47	45	Mantra meditation (30 groups, 28 studies) RR (14); [304,306,475,504b91,265,283,284,288,396,558,594,625,938] TM® (9); [186,279,392,424,519,677,683,782,796] Mantra (NS) (3); [260,503,965] CSM (2) [537,627] Yoga (9 groups, 9 studies) [134,177,181,204,219,224,615,858,868] Mindfulness meditation (6 groups, 6 studies) Zen Buddhist meditation (3); [70,500,639] MM (NS) (2); [728,932] MBSR (1) [754] Meditation practices (ND) (2 groups, 2 studies) [274,539,915]
	Education	46	44	Mantra meditation (19 groups, 17 studies) TM® (9); [205,206,210,220,221,407,659,714,787] RR (5); [94,192,218,234,476] Mantra (NS) (2); [483,777] CSM (1)[702] Mindfulness meditation (10 groups, 10 studies) MBSR (5); [423,575,579,689,756] Zen Buddhist meditation (3); [197,225,237] MM (NS) (2) [403,448] Yoga (8 groups, 8 studies) [118,212,216,461,462,562,926,1007] Tai Chi (6 groups, 6 studies) [235,307,397,665,746,878] Meditation practices (ND) (2 groups, 2 studies) [656,910] Miscellaneous meditation practices (1 groups, 1 study) [791]
	PMR	39	39	Mantra meditation (27 groups, 27 studies) TM® (10); [86,220,221,429,528,545,769,945,986,1005] RR (8); [191,265,288,475,477,569,616,988] Mantra (NS) (5); [472,531,577,626,736] CSM (3); [97,193,627] ACEM meditation (1) [961] Yoga (6 groups, 6 studies) [122,204,389,549,615,991] Mindfulness meditation (5 groups, 5 studies) MBSR (2); [196,263] MM (NS) (2); [696,751] Zen Buddhist meditation (1) [765] Meditation practices (ND) (1 group, 1 study) [494b]

Table G7. Type of control groups for intervention studies on meditation practices (continued)

Type of control group		N groups	N studies	References
Active (positive) concurrent controls—interventions other than meditation practices	Cognitive behavioral techniques	22	20	Mantra meditation (9 groups, 9 studies) TM® (3); [545,674,677; RR (3) 476,616,637] CSM (2); [410,702] Mantra (NS) (1) [483] Mindfulness meditation (7 groups, 7 studies) MM (NS) (4); [241,444,474,775] MBSR (3) [482,579,687] Meditation practices (ND) (3 groups, 2 studies) [656,987] Yoga (3 groups, 2 studies) [120 946]
	Miscellaneous active controls	23	19	Yoga (7 groups, 6 studies) [138,226,273,679,825,943] Mantra meditation (6 groups, 6 studies) RR (3);[396,558,592] Mantra (NS) (2);[494a719] TM® (1) [270] Mindfulness meditation (6 groups, 4 studies) MBSR (2);[195,754] Zen Buddhist meditation (1);[225] MM (NS) (1) [490] Miscellaneous meditation practices (2 groups, 1 study) [507] Meditation practices (ND) (1 group, 1 study) [198] Tai Chi (1 group, 1 study) [1001]
	Group therapy	14	13	Mantra meditation (6 groups, 6 studies) RR (3);[236,394,637] TM® (2);[261,816] ACEM meditation (1) [961] Mindfulness meditation (3 groups, 3 studies) MBSR (1); [482] MM (NS) (2) [241,738] Tai Chi (3 groups, 2 studies) : [391,768] Yoga (2 groups, 2 studies) [269,618]
	Psychotherapy	3	3	Mantra meditation (1 group, 1 study) TM® (1) [478] Mindfulness meditation (1 group, 1 study) MBSR (1) [752] Yoga (1 group, 1 study) [273]
	BF	13	12	Mantra meditation (12 groups, 11 studies) RR (6);[208,306b306a191,209,228] Mantra (NS) (3);[194,503,531] TM® (2); [270,683] Yoga (1 group, 1 study) [273]

Table G7. Type of control groups for intervention studies on meditation practices (continued)

Type of control group		N groups	N studies	References
Active (positive) concurrent controls—interventions other than meditation practices	Reading	8	8	Mantra meditation (6 groups, 6 studies) RR (4); [521,567,572,592] TM® (2) [587,759] Tai Chi (1 group, 1 study) [307] Yoga (1 group, 1 study) [615]
	Pharmacological interventions	8	8	Yoga (6 groups, 6 studies) [138,217,806,809,818,841] Qi Gong (2 groups, 2 studies) [211,262]
	Hypnosis	4	4	Mantra meditation (2 groups, 2 studies) TM® (2) [75,460] Meditation practices (ND) (2 groups, 2 studies) [494b198]
	Massage	3	2	Mantra meditation (2 groups, 1 study) RR (1) [558] Mindfulness meditation (1 group, 1 study) MBSR (1) [556]
	Acupuncture	1	1	Tai Chi (1 group, 1 study) [1001]
Active (positive) concurrent controls—meditation practices as comparison groups	Yoga	5	5	Mantra meditation (4 groups, 4 studies) TM® (3); [793,796,816] Mantra (NS) (1) [597] Meditation practices (ND) (1 group, 1 study) [656]
	Mantra meditation	3	3	Yoga (3 groups, 3 studies) [169,174,175]
	Mindfulness meditation	3	3	Mantra meditation (2 groups, 2 studies) TM® (1); [279] Mantra (NS) (1) [494a] Meditation practices (ND) (1 group, 1 study) [783]
	Meditation practices (ND)	2	2	Mantra meditation (2 groups, 2 studies) RR (1); [530] TM® (1) [1005]
	Tai Chi	1	1	Mantra meditation (1 group, 1 study) RR (1) [480]
Different dose or regimen of meditation practices—concurrent control groups	Yoga	15	14	Yoga (15 groups, 14 studies) [111,127,140,175-185]
	Mantra meditation	9	9	Mantra meditation (9 groups, 9 studies) TM® (5); [186-190] RR (2); [191,192] CSM (1); [193] Mantra (NS) (1) [194]
	Mindfulness meditation	5	4	Mindfulness meditation (5 groups, 4 studies) MBSR (2); [195,196] Zen Buddhist meditation (1); [197] MM (NS) (1) [395]
	Meditation practices (ND)	2	2	Meditation practices (ND) (2 groups, 2 studies) [198,199]

Table G7. Type of control groups for intervention studies on meditation practices (continued)

Type of control group		N groups	N studies	References
Usual care		37	37	Mindfulness meditation (9 groups, 9 studies) MM (NS) (2); [249,258;] MBSR (2) [556,773,934] MBCT (3); [929 427,940] Zen Buddhist (1) [227] Qi Gong (3 groups, 3 studies) [243,900,919] Mantra meditation (2 groups, 2 studies) RR (1)[268] TM® (2) [78,270] Tai Chi (4 groups, 4 studies) [246,566,573,904] Yoga (16 groups, 16 studies) [238-240,250,278,308,404,543,544,642,794,824,829,832,852,866] Meditation practices (ND) (1 group, 1 study) [274] Miscellaneous meditation practices (1 group, 1 study)[726]
Control groups (ND)		6	6	Mantra meditation (2 groups, 2 studies) RR (1); [234] TM® (1) [267] Qi Gong (2 groups, 2 studies) [953,977] MM (NS) (1); [242] Tai Chi (1 groups, 1 studies) [871]
Number of controls per study	Single control	275	275	Yoga (80 groups, 80 studies) [118,120,126,127,134,137,168,170,172,174,176,178-180,182-184,212,216,219,224,226,233,238-240,247,250,251,266,269,278,281,308,325,389,404,415,445,542-544,549,562,584,642,764,794,799,804,809,811,818,819,823,824,826,829,832,834,836-839,841,844,846,852,854,858,860,864,866,868,925,926,971,981,991,998] Mantra meditation (77 groups, 77 studies) TM® (34); [171,189,205,206,210,252,261,267,271,289,291-293,309,392,407,418,424,429,433,440,463,478,518,519,538,557,587,662,705,714,758,759,782,787,974] RR (23); [236,306,460,504a92,94,209,218,268,283,515,521,530,567,569,572,594,610,625,673,678,938,988] Mantra (NS) (9); [203,260,577,650,706,736,761,805,965] CSM (6); [97,384,410,536,658,676] ACEM meditation (2); [956,959] Cayce's meditation (1) [680] Mindfulness meditation (55 groups, 55 studies) MBSR (25) [167,244,245,263,272,419-421,423,485,493,512,589,593,602,681,687,689,691,710,711,752,756,773,934] MM (NS) (18) [106,242,249,258,386,430,444,447,448,523,532,696,738,751,762,775,932,1011]; MBCT (6); [427,455,553,929,940,984] Zen Buddhist meditation (6); [227,237,500,639,774,920] Tai Chi (40 groups, 40 studies) [223,246,248,285-287,290,326,391,397,398,408,409,413,435,437,467,489,566,573,595,596,603,617,631,645,698,713,746,789,871,878,882,885,894,895,904,955,999,1006] Qi Gong (12 groups, 12 studies) [207,211,213,214,243,405,767,900,919,953,954,977] Meditation practices (ND) (10 groups, 10 studies) [199,215,274,387,431,484,514,539,651,910] Miscellaneous meditation practices (1 group, 1 study) [726]

Table G7. Type of control groups for intervention studies on meditation practices (continued)

	Type of control group	N groups	N studies	References
Number of controls per study (continued)	Multiple controls	296	127	Mantra meditation (152 groups, 65 studies) TM® (25); [78,86,186-188,190,220,221,259,270,279,282,528,545,659,674,677,683,769,793,796,816,945,986,1005] RR (22); [208,234,304,306,394,475-477,480b75,91,191,192,228,265,284,288,396,558,592,616,637] Mantra (NS) (11); [472,483,494a194,434,503,531,597,626,719,777]; CSM (5) [193,264,537,627,702] ACEM meditation (1); [961] SRELAX (1) [222,] Yoga (63 groups, 26 studies) [111,122,138,140,169,175,177,181,185,204,217,273,280,305,417,461,462,615,618,666,679,806,825,943,946,1007] Mindfulness meditation (45 groups, 20 studies) MBSR (8); [195,196,482,556,575,579,754,930] MM (NS) (6); [241,395,403,474,490,728] Zen Buddhist meditation (6) [70,197,225,554,629,765] Meditation practices (ND) (17 groups, 7 studies) [494b198,656,730,783,915,987] Tai Chi (13 groups, 6 studies) [235,307,541,665,768,1001] Miscellaneous meditation practices (4 groups, 2 studies) [507,791] Qi Gong (2 groups, 1 study) [262]

Table G8. Type of control groups for observational analytical studies on meditation practices

Type of control group		N groups	N studies	References
Nonexposed cohorts/comparison groups		247	244	Mantra meditation (155 groups, 153 studies) TM® (140); [509,994a638,740,748,951a951b80,438,441,446,449-453,458,466,487,499,508,513,520,522,534,535,540,547,771,772,795,923,964,978,980,1008a547b551,552a552b560,563,568,570,571a400,401,576,581,585,600,601,612,619,624,776,817,927,928,970,975,976a624b422,428,633,640,643,644,646,648,649,655,660,661,663,668-672,685,686,688,693-695,703,712,717,718,721,723,779,781,790,835,950,972,983,993,997a950b385,436,469,501,509,700,731,734,737,741,745,757,760,763,792,936,941,1000,1003,1004b546,555,571b399,412,416,598,599,607,647,675,701,732,973b743,744,973a] Mantra (NS) (6); [591,828,853,859,937,969] ACEM meditation (4); [720,957,958,960] Ananda marga (3) [498,526,786] Yoga (29 groups, 29 studies) [141,142,146,390,465,473,496,506,527,574,667,785,798,803,807,820,833,842,849,855,857,861,865,869,949,968,985,1009,1010] Mindfulness meditation (21 groups, 21 studies) Zen Buddhist meditation (12); [105,443,456,495,636,729,742,886,917,918,924,995] MM (NS) (6); [479,486,497,511,605,641] Vipassana (3) [664,921,990] Tai Chi (22 groups, 21 studies) [388,432,470,565,735,874,876,877,879-881,896,898,899,901-903,905,908,909,911] Qi Gong (13 groups, 13 studies) [161,200,201,632,778,884,887,888,890,892,893,907,912] Miscellaneous meditation practices (5 groups, 5 studies) [454,628,933,935,967] Meditation practices (ND) (2 groups, 2 studies) [481,630]
Active (positive) concurrent controls exposed to interventions other than meditation practices	Exercise/physical activity	16	14	Tai Chi (4 groups, 4 studies) [470,565,879,903] Yoga (4 groups, 4 studies) [390,755,842,989] Miscellaneous meditation practices (4 groups, 2 studies) [933,935] Mantra meditation (2 groups, 2 studies) TM® (2) [529,704] Meditation practices (ND) (1 group, 1 study) [481] Qi Gong (1 group, 1 study) [202]
	Miscellaneous active controls	7	5	Mantra meditation (5 groups, 3 studies) TM® (3) [439,522,939] Miscellaneous meditation practices (1 group, 1 study) [935] Tai Chi (1 group, 1 study) [699]
	Progressive muscle relaxation	5	4	Mantra meditation (5 groups, 4 studies) TM® (4) [509a509b508,749]
	Hypnosis	3	3	Mantra meditation (3 groups, 3 studies) TM® (3) [655,741,952]
	Rest and states of relaxation	3	3	Mantra meditation (3 groups, 3 studies) TM® (3) [453,586,939]
	Education	2	2	Qi Gong (1 group, 1 study) [202] Yoga (1 group, 1 study) [755]

MM = mindfulness meditation; ND = not described; NS = not specified; RR = Relaxation Response; TM® = Transcendental Meditation®

Table G8. Type of control groups for observational analytical studies on meditation practices (continued)

Type of control group		N groups	N studies	References
Active (positive) concurrent controls exposed to interventions other than meditation practices	Group therapy	2	2	Mantra meditation (1 group, 1 study) TM® (1) [439] Yoga (1 group, 1 study) [527]
	Reading	2	2	Mindfulness meditation (1 group, 1 study) Zen Buddhist meditation (1) [550] Yoga (1 group, 1 study) [948]
	Biofeedback	1	1	Mantra meditation (1 group, 1 study) RR (1) [492]
	Cognitive behavioral techniques	1	1	Mantra meditation (1 group, 1 study) TM® (1) [583]
Active (positive) concurrent controls exposed to meditation practices	Mantra meditation	2	2	Mindfulness meditation (2 groups, 2 studies) Zen Buddhist meditation (1); [456] MM (NS) (1) [614]
	Mindfulness meditation	2	2	Mantra meditation (2 groups, 2 studies) TM® (1); [453] Mantra (NS) (1) [937]
	Meditation practices (ND)	2	2	Yoga (1 group, 1 study) [141] Meditation practices (ND) (1 group, 1 study) [481]
	Tai Chi	1	1	Qi Gong (1 group, 1 study) [907]
	Yoga	4	4	Mantra meditation (2 groups, 2 studies) TM® (2) [509a817] Mindfulness meditation (1 group, 1 study) Zen Buddhist meditation (1) [456] Qi Gong (1 group, 1 study) [202]
Concurrent control groups exposed to different dose or regimen of the same meditation practice	Mantra meditation	21	20	Mantra meditation (21 groups, 20 studies) TM® (17); [436,509b522,546,548,571b412,582,586,607,655,675,722,732,740,748,994] Ananda marga (2); [498,786] Mantra (NS) (1) [591]
	Mindfulness meditation	8	6	Mindfulness meditation (8 groups, 6 studies) Zen Buddhist meditation (4); [729,742,917,924] Vipassana (1); [708] MM (NS) (1) [511]
	Qi Gong	11	6	Qi Gong (11 groups, 6 studies) [161,873,884,888,890,892]
	Yoga	3	3	Yoga (3 groups, 3 studies) [788,820,869]
	Tai Chi	1	1	Tai Chi (1 group, 1 study) [911]

Table G8. Type of control groups for observational analytical studies on meditation practices (continued)

Type of control group		N groups	N studies	References
Historical controls		14	14	Mantra meditation (11 groups, 11 studies) TM® (10); [400,450,452,600,601,624,771,970a624b688] Ananda marga (1) [720] Qi Gong (3 groups, 3 studies) [200-202]
Number of controls per study	Single control	207	207	Mantra meditation (136 groups, 136 studies) TM® (126); [951a951b80,385,438,446,449-452,458,466,469,487,499,501,513,520,529,534,535,540,547,771,772,795,923,952,964,978,980,1008a547b548,551,552a552b555,560,563,568,570,571a399-401,576,581-583,585,598-601,612,619,624,776,927,928,970,975,976a624b416,422,428,633,638,640,643,644,646-649,661,663,668-672,685,686,688,693-695,700,701,703,704,712,717,718,721,723,779,781,790,835,950,972,983,993,997a950b731,734,936,973b973a737,743-745,757,760,763,792,941,1000,1003,1004] ACEM meditation (4); [720,957,958,960] Mantra (NS) (4); [828,853,859,969] Ananda marga (1); [526] RR (1) [492] Yoga (26 groups, 26 studies) [142,146,465,473,496,506,574,667,785,788,798,803,807,833,849,855,857,861,865,948,949,968,985,989,1009,1010] Mindfulness meditation (17 groups, 17 studies) Zen Buddhist meditation (8); [105,443,495,550,636,886,918,995] MM (NS) (6); [479,486,497,605,614,641] Vipassana (3) [664,921,990] Tai Chi (16 groups, 16 studies) [388,699,735,874,876,877,880,881,896,898,899,901,902,905,908,909] Qi Gong (8 groups, 8 studies) [200,201,632,778,873,887,893,912] Miscellaneous meditation practices (3 groups, 3 studies) [454,628,967] Meditation practices (ND) (1 group, 1 study) [630]
	Multiple controls	137	59	Mantra meditation (65 groups, 29 studies) TM® (25); [436,439,441,453,508,509a509b522,546,571b412,586,607,655,660,675,722,732,740,741,748,749,817,939,994] Ananda marga (2); [498,786] Mantra (NS) (2) [591,937] Mindfulness meditation (16 groups, 7 studies) Zen Buddhist meditation (5); [456,729,742,917,924] MM (NS) (1); [511] Vipassana (1) [708] Yoga (14 groups, 7 studies) [141,390,527,755,820,842,869] Qi Gong (20 groups, 7 studies) [161,202,884,888,890,892,907] Tai Chi (12 groups, 6 studies) [432,470,565,879,903,911] Miscellaneous meditation practices (7 groups, 2 studies): [933,935] Meditation practices (ND) (3 groups, 1 study) [481]

Table G9. Meditation practices separated by the diseases, conditions, and populations for which they have been examined

Category of meditation practices	Meditation practice	N	Study populations/conditions and associated references
Mantra meditation (337)	TM®®	231	Intervention studies (80) *Healthy populations (57)* College/university students (24); [186,187,189,293,424,429,433,463,518,519,538,545,659,662,705,750,758,769,782,793,796,945,986,1005] Healthy volunteers from the community (19); [171,190,291,324,392,407,418,471,505,528,533,561,677,709,733,815,942,996,1002]; Prison inmates (4); [188,289,557,974] Workers (4); [86,292,440,714] Elderly (3); [78,279,282] Smokers (2); [674,787] Athletes (1) [309] *Mental health disorders (9)* Substance abuse (5); [259,261,267,270,271] Anxiety disorders (2);[683,814] Miscellaneous psychiatric conditions (1); [850] Posttraumatic stress disorder (1) [478] *Circulatory/cardiovascular (10)* Coronary artery disease (1);[252] Hypertension (9) [205,206,210,220-222,295,311,319] *Respiratory/Pulmonary (2)* Asthma (2) [587,759] *Sleep disorders (1)* Chronic insomnia (1) [780] *Oncology (1)* Cancer (miscellaneous) (1) [816] Observational analytical (151) *Healthy populations (148)* Healthy volunteers from the community (91); [951a951b385,446,449-452,499,508,509,771,795,952,978,980,1008a509b80,513,522,529,546,551,555,560,563,571,923,964a571b399,400,576,581,583,585,586,598-601,607,612,624,776,928,970,975,976a624b412,416,422,428,633,638,640,643,644,646,647,649,655,669,675,686,695,700,703,704,717,722,723,731,779,972,973,983,993,994,997b973a745,748,749,760,792,939,941,1004] College/university students (48); [436,458,466,487,501,520,534,535,540,547,772a547b401,548,568,570,582,648,660,661,663,668,671,672,685,688,693,694,712,718,721,781,790,817,835,927,950a950b732,734,737,741,744,757,763,936,1000,1003] Elderly (5);[453,552a552b701,740] Prison inmates (3); [438,439,441] Workers (1) [670] *Gynecology (2)* Pregnancy (1); [469] Postmenopause (1) [743] *Dental (1)* Periodontitis (1) [619]
	RR	51	Intervention studies (50) *Healthy populations (31)* College/university students (19); [306,394,475-477b306a75,191,515,524,530,558,567,569,572,616,625,938,988] Healthy volunteers from the community (8); [94,283,284,288,304,480,525,594] Prison inmates (1); [92] Workers (3) [504,637,673] *Circulatory/cardiovascular (9)* Other cardiovascular diseases (5); [91,234,236,459,753] Hypertension (4) [208,209,218,228] *Mental health disorders (4)* Substance abuse (2); [265,268] Anxiety disorders (1); [460] Schizophrenia or antisocial personality disorders (1) [678] *Gynecology (2)* Menopause (1) [592]; Premenstrual syndrome (1) [396] *Gastrointestinal (1)* Irritable bowel syndrome (1) [610] *Miscellaneous medical conditions (1)* Heterogeneous patient population (1) [414] *Musculoskeletal (1)* Total knee replacement (1) [192] *Oncology (1)* Skin cancer (1) [521] Observational analytical (1) *Circulatory/cardiovascular:* Hypertension (1) [492].

COPD = chronic obstructive pulmonary disease; CSM = clinically standardized meditation; DM = diabetes mellitus; HIV = human immunodeficiency virus; MBCT = mindfulness-based cognitive therapy; MBSR = mindfulness-based stress reduction; MM = mindfulness meditation; ND = not described; NS = not specified; RR = Relaxation Response; TM® = Transcendental Meditation®

Table G9. Meditation practices separated by the diseases, conditions, and populations for which they have been examined (continued)

Category of meditation practices	Meditation practice	N	Study populations/conditions and associated references
Mantra meditation (continued)	Mantra meditation (ND)	32	Intervention studies (26) *Healthy populations (19)* College/university students (10); [472,494a531,597,650,653,654,706,719,965] Healthy volunteers from the community (6); [393,434,503,652,777,856] Workers (2); [483,761] Army/military (1) [194] *Mental health disorders (5)* Anxiety disorders (3);[577,626,736] Substance abuse (1);[260] Miscellaneous psychiatric conditions (1) [963] *Circulatory/cardiovascular (1)* Hypertension (1) [203] *Neurological (1)* Epilepsy (1) [805] Observational analytical (6) *Healthy populations (6)* Healthy volunteers from the community (6) [591,828,853,859,937,969]
	CSM	11	Intervention studies (11) *Healthy populations (7)* College/university students (3); [537,658,676] Workers (3); [193,384,536] Healthy volunteers from the community (1) [627] *Mental health disorders (3)* Anxiety disorders (1); [97] Schizophrenia (1); [410] Substance abuse (1) [264] *Sleep disorders (1)* Chronic insomnia (1) [702]
	ACEM meditation	7	Intervention studies (3) *Healthy populations (3)* Athletes (3) [956,959,961] Observational analytical (4) *Healthy populations (4)* Healthy volunteers from the community (4) [720,957,958,960]
	Ananda marga	3	Observational analytical (3) *Healthy populations (3)* Healthy volunteers from the community (3) [498,526,786]
	Cayce's meditation	1	Intervention studies (1) *Healthy populations (1)* Healthy volunteers from the community (1) [680]
	Concentrative/ rosary prayer	1	Intervention studies (1) *Healthy populations (1)* Healthy volunteers from the community (1) [966]
Yoga		191	Intervention studies (158) *Healthy populations (80)* Healthy volunteers from the community (34); [83,111,122,126,133,140,180,183,301,302,310,312,318,320,322,323,406,411,491,578,707,739,799,821,822,826,858,860,863,864,867,979,981,992] College/university students (26); [127,134,172,177-179,181,182,297,300,305,314,315,389,462,468,615,800,802,823,838,840,854,862,971,982] Army/military (7); [137,313,811,836,837,839,844] Elderly (5); [280,281,445,562,825] Workers (5) [169,176,549,679,1007] Prison inmates (2); [175,812] Athletes (1) [834] *Circulatory/cardiovascular (21)* Hypertension (13); [185,204,212,216,217,219,224,226,294,303,510,831,851] Cardiovascular diseases (8) [233,238-240,247,250,251,611]; *Mental health disorders (16)* Depression (7);[138,184,618,764,806,819,830] Anxiety disorders (3); [810,841,846] Substance abuse (3); [266,269,273] Obsessive-compulsive disorder (1);[174] Miscellaneous psychiatric conditions (1); [170] Neurosis (1) [809]

Table G9. Meditation practices separated by the diseases, conditions, and populations for which they have been examined (continued)

Category of meditation practices	Meditation practice	N	Study populations/conditions and associated references
Yoga (continued)		192	*Respiratory/Pulmonary (13)* Asthma (9);[168,325,813,818,829,843,866,943,991] Chronic airways obstruction (1)[998] Chronic bronchitis (1);[797] Pleural effusion (1);[832] Pulmonary tuberculosis (1)[868] *Muscoloskeletal (11)* Chronic pain (2);[118,542] Rheumathoid arthritis (2);[804,925] Carpal tunnel syndrome (1);[544] Chronic rheumatic diseases (1);[845] Fibromyalgia (1);[584] Hyperkyphosis (1);[559] Multiple sclerosis (1);[666] Osteoarthritis (1);[543] Post-polio syndrome (1)[516] *Endocrine (7)* Type 2 DM (7)[278,298,308,321,794,824,926] *Gastrointestinal (2)* Irritable bowel syndrome (1);[852] Miscellaneous gastrointestinal disorders (1)[827] *Neurological (2)* Epilepsy (1);[417] Migraine/tension headaches (1)[404] *Gynecology (1)* Pregnancy (1)[415] *Immunologic (1)* HIV (1)[642] *Miscellaneous medical conditions (1)* Heterogeneous patient population (1)[870] *Oncology (1)* Lymphoma (1)[120] *Sleep disorders (1)* Chronic insomnia (1)[613] *Vestibular (1)* Tinnitus (1)[946] Observational analytical (33) *Healthy populations (33)* Healthy volunteers from the community (23);[141,146,390,465,473,506,527,574,667,798,803,820,833,842,855,861,865,948,949,968,985,989,1009] College/university students (7);[142,755,785,788,807,857,869] Workers (2);[496,849] Elderly (1)[1010]
Mindfulness meditation (127)	MBSR	49	Intervention studies (49) *Healthy populations (12)* College/university students (6);[457,488,517,689,711,754] Healthy volunteers from the community (3);[485,602,756] Workers (3)[512,593,710] *Mental health disorders (12)* Anxiety disorders (3);[196,589,606] Mood disorders (2);[681,752] Substance abuse (2);[263,272] Binge eating disorder (1);[620] Burnout (1);[493] Miscellaneous psychiatric conditions (1);[622] Personality disorders (1);[773] Parents of children with behavioral problems (1)[687] *Miscellaneous medical conditions (6)* Heterogeneous patient population (5);[579,684,691,692,947] Chronic fatigue (1)[934] *Musculoskeletal (6)* Chronic pain (4);[420,482,556,682] Fibromyalgia (2)[421,609] *Oncology (4)* Breast cancer (3);[423,575,724] Prostate cancer (1)[697] *Dermatology (2)* Psoriasis (2)[167,195] *Circulatory/Cardiovascular (2)* Cardiovascular diseases (2)[244,245] *Neurological (2)* Traumatic brain injuries (2)[770,930] *Endocrine (1)* Obesity (1)[635] *Immunologic (1)*HIV (1)[419] *Organ transplantation (1)* Kidney, lung, pancreas (1)[402]

Table G9. Meditation practices separated by the diseases, conditions, and populations for which they have been examined (continued)

Category of meditation practices	Meditation practice	N	Study populations/conditions and associated references
Mindfulness meditation (127) (continued)	MM (NS)	37	Intervention studies (30) *Healthy populations (11)* College/university students (7); [106,447,490,523,696,728,775] Athletes (1); [762] Healthy volunteers from the community (1); [532] Smokers (1); [444] Workers (1) [932] *Mental health disorders (5)* Binge eating disorders (2); [403,474] Anxiety disorders (1); [751] Psychosis (1); [922] Substance abuse (1) [258] *Musculoskeletal (5)* Fibromyalgia (3); [430,448,716] chronic pain (2) [464,604] *Circulatory/Cardiovascular (3)* Cardiovascular diseases (3) [241,242,249] *Oncology (3)* Cancer (miscellaneous) (3) [386,442,738] *Dermatology (1)* Psoriasis (1) [395] *Gynecology (1)* Infertility (1) [1011] *Miscellaneous medical conditions (1)* Heterogeneous patient population (1) [727] Observational analytical (7) *Healthy populations (6)* College/university students (4); [497,511,614,641] Healthy volunteers from the community (2) [479,486] *Musculoskeletal (1)* Chronic pain (1) [605]
	Zen Buddhist meditation	28	Intervention studies (15) *Healthy populations (11)* College/university students (10); [70,426,500,554,629,639,774,913,916,920] Healthy volunteers from the community (1) [197] *Circulatory/Cardiovascular:* Cardiovascular diseases (1); [237] Hypertension (2) [225,227] *Sleep disorders (1)* Insomnia (1) [765] Observational analytical (13) *Healthy populations (13)* Healthy volunteers from the community (12); [105,443,456,495,550,636,729,742,886,917,924,995] College/university students (1) [918]
	MBCT	7	Intervention studies (7) *Mental health disorders (3)* Depression (3) [427,929,940] *Healthy populations (1)* Workers (1) [984] *Musculoskeletal (1)* Fibromyalgia [553] *Neurological (1)* Stroke (1) [784] *Vestibular (1)* Tinnitus (1) [455]
	Vipassana meditation	6	Intervention studies (2) *Healthy populations*: Healthy volunteers from the community (1) [848] *Neurological (1)* Migraine/Tension headaches (1) [847] Observational analytical (4) *Healthy populations (4)* Healthy volunteers from the community (2); [708,990] College/university students (1); [921] Elderly (1) [664]

Table G9. Meditation practices separated by the diseases, conditions, and populations for which they have been examined (continued)

Category of meditation practices	Meditation practice	N	Study populations/conditions and associated references
Tai Chi		88	Intervention studies (66) *Healthy populations (38)* Elderly (25); [285,287,290,326,397,398,408,409,425,435,489,566,588,603,631,645,657,665,690,698,872,878,882,885,931] Healthy volunteers from the community (8); [152,286,296,307,595,596,766,906] College/university students (4); [317,715,747,789] Workers (1) [955] *Musculoskeletal (13)* Rheumatoid arthritis (4); [617,746,883,962] Osteoarthritis (3); [573,894,904] Chronic pain (2); [437,467] Balance disorders (1); [564] Fibromyalgia (1); [725] Multiple sclerosis (1); [590] Osteoporosis (1) [713] *Circulatory/Cardiovascular (4)* Cardiovascular diseases (3); [235,246,248] Hypertension (1) [223] *Gynecology (2)* Menopause (1); [1001] Postmenopause (1) [895] *Mental health disorders (2)* Depression (1); [871] Miscellaneous psychiatric conditions (1) [768] *Neurological (2)* Developmental disabilities (1); [608] Stroke (1) [1006] *Endocrine (1)* Type 2 DM (1) [999] *Immunologic (1)* HIV (1) [541] *Oncology (1)* Breast cancer (1) [391] *Renal (1) :* End-stage renal disease (1) [897] *Vestibular (1)* Vestibulopathy (1) [413] Observational analytical (22) *Healthy populations (20)* Elderly (18); [388,432,565,735,874,876,879-881,896,898,901-903,905,908,909,911] Healthy volunteers from the community (2) [470,699] *Gynecology (2)*Postmenopause (2) [877,899]
Qi Gong		37	Intervention studies (22) *Healthy populations (7)* Healthy volunteers from the community (4); [299,405,634,891] College/university students (2); [316,977] Elderly (1) [889] *Circulatory/cardiovascular (5)* Hypertension (4); [207,211,213,214] Cardiovascular diseases (1); [243] *Musculoskeletal (4)* Fibromyalgia (2); [502,953] Muscular dystrophy (1); [954] Regional pain syndrome (1) [767] *Endocrine (2)* Type 2 DM (2) [914,919] *Mental health disorders (1)* Substance abuse (1) [262] *Miscellaneous medical conditions (1)* Heterogeneous patient population (1) [900] *Neurological (1)* Migraine/Tension headaches (1) [944] *Respiratory/Pulmonary (1)* COPD (1) [875] Observational analytical (15) *Healthy populations (14)* Healthy volunteers from the community (11); [161,200,201,632,778,884,887,888,890,892,893] College/university students (2); [202,912] Elderly (1) [907] *Circulatory/Cardiovascular (1)* Hypertension (1) [873]

Table G9. Meditation practices separated by the diseases, conditions, and populations for which they have been examined (continued)

Category of meditation practices	Meditation practice	N	Study populations/conditions and associated references
Meditation practices (ND)		21	Intervention studies (19) *Healthy populations (12)* College/university students (9); [387,494b199,431,539,580,656,730,915] Workers (2); [514,910] Healthy volunteers from the community (1) [651] *Mental health disorders (4)* Substance abuse; (2) [274,808] Anger management problems (1); [987] Mood disorders (1) [783] *Circulatory/cardiovascular (1)* Hypertension (1) [215] *Dental problems (1)* Dental problems (1) [198] *Sleep disorders (1)* Insomnia (1) [484] Observational analytical (2) *Healthy populations (1)* College/university students (1) [481] *Mental health disorders (1)* Miscellaneous psychiatric conditions (1) [630]
Miscellaneous meditation practices		11	Intervention studies (6) *Healthy populations (3)* College/university students (2); [507,791] Healthy volunteers from the community (1) [623] *Mental health disorders (1)* Miscellaneous psychiatric conditions (1) [621] *Miscellaneous medical conditions (1)* Heterogeneous patient population (1) [801] *Oncology (1)* Breast cancer (1) [726] Observational analytical (5) *Healthy populations (5)* Healthy volunteers from the community (4); [454,628,933,967] College/university students (1) [935]

Appendix H. Characteristics of Clinical Trials of Meditation Practices for the Three Most Studied Conditions

Table H1. Characteristics of clinical trials of meditation practices in hypertension

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Aivazyan, TA 1988[203] Russia	RCT parallel 2 arms Duration: 12 mo ITT: yes	35.7 yr F = 0 M = 117 Mild HT (DBP 90-105 mm Hg)	R: 146 C: 117 W: 29	Composite Mantra meditation + relaxation techniques	R: 90 C: 70 W: 20	NT	R: 56 C: 47 W: 9	Primary: BP changes (SBP, DBP) Secondary: time of BP restoration, HRQL, emotional stress, number of sick leaves	The intervention produced a significant antihypertensive effect lasting for 1 yr in outpatients with mild hypertension The intervention produced reduction in psychophysiological reactivity The intervention produced improvement in psychological adaptation and capacity for work

AHM = anti-hypertensive medication; AI = alpha index; APO-A1 = apolipoprotein A1; AT = autogenic training; BE = breathing exercises; BF = biofeedback; BHT = borderline hypertension; BMI = body mass index; BP = blood pressure; C = number completed; cIMT = carotid intima media thickness; CMBT = contemplative meditation with breathing techniques; CO = cardiac output; CPR = cold pressor response; Cr = creatinine; d = day(s); DBH = dopamine beta hydroxylase; DBP = diastolic blood pressure; E = number enrolled (for NRCTs); E/A ratio = early filling divided by atrial constriction; EEG = electroencephalogram; EMG = electromyography; EPI = epinephrine; FEV_1 forced expiratory volume in 1 second; FVC = forced vital capacity; GSR = galvanic skin response; HDL-C = high density lipoprotein cholesterol; HE = health education; HR = heart rate; HRQL = health-related quality of life; HT = hypertension; IHD = ischemic heart disease; ITT = intention to treat; IVST = intraventricular septal thickness; JNC 7 = Joint National Committee 7; K = potassium; LDL-C = low density lipoprotein cholesterol; LVIDD = left ventricular internal dimension at diastole; LVDIS = left ventricular internal dimension at systole; LVMI = left ventricular mass index; MI = myocardial infarction; mo = month(s); Na = sodium; NA = not applicable; NE = norepinephrine; NR = not reported; NRCT = nonrandomized controlled trial; NS = not specified; NT = no treatment; PLB = placebo; PMR = progressive muscle relaxation; PRA = plasma renin activity; pR = Pulse rate; PWT = posterior wall thickness; R = number randomized (for RCTs); RPP = rate pressure product; RR = Relaxation Response; SBP = systolic blood pressure; TC = total cholesterol; TG = triglycerides; TM® = Transcendental Meditation®; wk = week(s); UC = usual care; W = number withdrawals/losses to folloup; WL = waiting list; yr = year(s); 18-OH-OHDOC = hydroxydeoxycorticosterone

Table H1. Characteristics of clinical trials of meditation practices in hypertension (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Broota A, 1995[204] India	RCT parallel 4 arms Duration: 8 d ITT: No	35-59 yr F = 0 M = 40 Essential HT (NR)	R: NR C: 40 W: NR	Single Yoga	R: NR C: 10 W: NR	Broota	R: NR C: 10 W: NR	Primary: BP changes (SBP, DBP) Secondary: anxiety, GSR	The three therapies are effective in reducing symptoms of hypertension when compared to the NT group Yoga was the most effective followed by the Broota technique and PMR
						PMR	R: NR C: 10 W: NR		
						NT	R: NR C: 10 W: NR		
Calderon R Jr, 2000[205] United States	RCT parallel 2 arms Duration: 6 mo ITT: NR	53.9 yr F = 48 M = 24 Mild HT (SBP 130-140 mm Hg and DBP 85-89 mm Hg or SBP 140-150 mm Hg and DBP 90-99 mm Hg)	R: 146 C: 72 W: 74	Single TM®	R: NR C: 36 W: NR	HE	R: NR C: 36 W: NR	Primary: TC, TG. LDL-C, HDL-C Secondary: BP changes, PR, anger, personal efficacy, diet, stress, physical activity	There were no significant reductions in TC, TG, LDL-C and no significant increase in HDL-C between groups Both groups showed significant positive changes in BP, PR, diet, and psychological measures

Table H1. Characteristics of clinical trials of meditation practices in hypertension (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Castillo-Richmond A, 2000[206] United States	RCT parallel 2 arms Duration: 9 mo ITT: Yes	53.8 yr F = 41 M = 19 Mild to moderate HT (SBP 130-139 mm Hg and DBP 80-85 mm Hg [high normal]; SBP 140-159 mm Hg and DBP 90-99 mm Hg [stage I]; SBP 160-179 mm Hg and DBP 100-109 mm Hg [stage 2])	R: 138 C: 60 W: 78	Single TM®	R: NR C: 31 W: NR	HE	R: NR C: 29 W: NR	Primary: cIMT Secondary: BP changes, weight, PR, pulse pressure, TC, HDL-C, LDL-C, smoking, exercise	Stress reduction with TM® is associated with reduced cIMT There were no significant changes associated with TM® for the other outcomes

Table H1. Characteristics of clinical trials of meditation practices in hypertension (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Cheung BMY, 2005[207] Hong Kong	RCT parallel 2 arms Duration: 16 wk ITT: Yes	54.4 yr F = 51 M = 37 Mild HT (SBP 140-170 mm Hg and/or DBP 90-105 mm Hg)	R: 91 C: 88 W: 3	Single Qi Gong	R: 47 C: 47 W: 0	Exercise	R: 44 C: 44 W: 3	Primary: BP, health status, anxiety, depression Secondary: HR, weight, BMI, body fat, waist/hip circumference, renin excretion, urinary albumin excretion, Na, K, urea, Cr, TC, HDL-C, LDL-C, TG, aldosterone, urine cortisolurine, Cr, urine Na, urine protein, LVMI, ejection fraction	Qi Gong and conventional exercise have similar effects on BP in patients with mild HT Qi Gong is not superior to conventional exercise but can be used as an alternative to conventional exercise in those who prefer it as a form of nonpharmacolo-gical management of HT
Cohen J, 1983[208] United States	RCT parallel 3 arms Duration: 10 wk ITT: NR	44.5 yr F = 17 M = 13 Essential HT (NR)	R: NR C: 30 W: NR	Single RR	R: NR C: 10 W: NR	BF	R: NR C: 10 W: NR	Primary: attention (field independence, attention deployment, absorption) Secondary: BP changes (SBP, DBP)	The BF group became significantly more field independent than RR and WL groups Increase in field independence in the BF group correlated with decreases in BP
						WL	R: NR C: 10 W: NR		

Table H1. Characteristics of clinical trials of meditation practices in hypertension (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Hafner RJ, 1982[185] United Kingdom	RCT parallel 3 arms Duration: 3 mo ITT: NR	48.9 yr F = NR M = NR Essential HT (NR)	R: 24 C: 22 W: 2	Composite Yoga + BF	R: 8 C: 7 W: 1	Yoga	R: 8 C: 7 W: 1	Primary: BP changes (SBP, DBP) Secondary: hostility, assertive behavior, psychological symptoms	The addition of BF to meditation does not enhance reduction of BP Overall reductions in blood pressure were not significantly greater in either program than in the control group
						NT	R: 8 C: 8 W: 0		
Hager JL, 1978[209] United States	RCT parallel 2 arms Duration: 4 wk ITT: No	Age NR F = NR M = NR BHT (SBP >145 mm Hg and/or DBP >95 mm Hg)	R: 30 C: 17 W: 13	Single RR	R: NR C: 10 W: NR	BF (BP)	R: NR C: 7 W: NR	Primary: BP changes (SBP, DBP)	Neither RR nor BF (BP) reduced SBP over the followup period Differences between RR and BF in BP reductions were not significant
Kondwani KA, 1998[210,229] United States	RCT parallel 2 arms Duration: 1 yr ITT: NR	50.7 yr F = 19 M = 15 Mild HT (DBP 90-104 mm Hg)	R: 42 C: 34 W: 8	Single TM®	R: 22 C: 19 W: 3	HE	R: 20 C: 15 W: 5	Primary: LVMI Secondary: BP changes (SBP, DBP), weight, HR, PWT, LVIDD, LVIDS, IVST, E/A ratio, energy, sleep, positive affect, sleep pattern, anxiety, depression, anger, self-efficacy, locus of control, diet, activity level, compliance	Both TM® and health education reduced LVMI The TM® group showed significant improvements in HRQL, diastolic function and DBP

Table H1. Characteristics of clinical trials of meditation practices in hypertension (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population		Intervention		Comparison groups		Outcomes	Authors' conclusions
		Age (mean/range), gender, diagnosis	N participants	Type/name	N participants	Type/name	N participants		
Kuang AK, 1987[211] China	RCT parallel 2 arms Duration: 1 yr ITT: NR	40-60 yr F = 0 M = 46 Essential HT (DBP 100-120 mm Hg)	R: NR C: 46 W: NR	Composite Qi Gong + AHM	R: NR C: 23 W: NR	AHM	R: NR C: 23 W: NR	Primary: plasma 18-OH-DOC levels Secondary: BP changes (SBP, DBP)	The addition of Qi Gong to AHM significantly reduced BP and plasma l8-0H-DOC
Latha DR, 1991[212] India	RCT parallel 2 arms Duration: 6 mo ITT: NR	45-70 yr F = NR M = NR Essential HT (NR)	R: 23 C: 14 W: 9	Composite Yoga + BF (thermal)	R: NR C: 7 W: NR	HE	R: NR C: 7 W: NR	Primary: BP changes (SBP, DBP) Secondary: AHM intake, stress control, negative responses to stress, coping be-havior, somatic symptoms, symp-tom severity	Training in yoga + BF was moderately effective in reducing SBP Thermal BF seems to be more effective in reducing DBP Training in Yoga and thermal BF was least effective in altering the perceptions associated with stressful experiences

Table H1. Characteristics of clinical trials of meditation practices in hypertension (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Lee MS, 2003[214,230] South Korea	RCT parallel 2 arms Duration: 10 wk ITT: NR	56.2 yr F = 35 M = 23 Essential HT (SBP 140-180 mm Hg and DBP 90-100 mm Hg)	R: 65 C: 58 W: 7	Single Qi Gong	R: 33 C: 29 W: 4	WL	R: 32 C: 29 W: 3	Primary: BP changes (SBP, DBP, RPP) Secondary: HR, PR, EPI, NE, FVC,[230] FEV_1,[230] cortisol, stress level	Qi Gong reduced SBP, DBP, NE, EPI, cortisol, and stress levels Qi Gong significantly improved ventilation functions Qi Gong is an effective nonpharmacological modality to reduce BP in essential HT
Lee MS, 2004[213,231] South Korea	RCT parallel 2 arms Duration: 8 wk ITT: NR	53.4 yr F = 22 M = 14 Essential HT (SBP 140-180 mm Hg and DBP 90-105 mm Hg)	R: 47 C: 36 W: 11	Single Qi Gong	R: 23 C: 17 W: 6	WL	R: 24 C: 19 W: 5	Primary: BP changes (SBP, DBP) Secondary: APO-A1, TC, HDL-C, TG, self-efficacy[231]	Qi Gong significantly reduced BP and changed lipid metabolism Qi Gong significantly enhances perceptions of self-efficacy

Table H1. Characteristics of clinical trials of meditation practices in hypertension (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Manikonda P, 2005[215] Germany	RCT parallel 2 arms Duration: 8 wk ITT: NR	30-70 yr F = 18 M = 34 Mild to moderate HT (JNC7 criteria)	R: NR C: 52 W: NR	Single CMBT	R: NR C: 26 W: NR	NT	R: NR C: 26 W: NR	Primary: BP changes	CMBT effectively reduces BP
McCaffrey R, 2005[216] Thailand	RCT parallel 2 arms Duration: 8 wk ITT: NR	56.4 yr F = 35 M = 19 Mild to moderate HT (BP>140/90 mm Hg)	R: 61 C: 54 W: 7	Single Yoga	R: 32 C: 27 W: 5	HE	R: 29 C: 27 W: 2	Primary: stress, BP changes (SBP, DBP) Secondary: BMI, HR	Practicing Yoga for 8 wk reduces stress, BP, BMI, and HR
Murugesan R, 2000[217] India	RCT parallel 3 arms Duration: 11 wk ITT: NR	35-65 yr F = NR M = NR Essential HT (NR)	R: NR C: 33 W: NR	Single Yoga	R: NR C: 11 W: NR	AHM	R: NR C: 11 W: NR	Primary: stress, BP changes (SBP, DBP) Secondary: PR, weight	Yoga was more effective than AHM in controlling SBP, PR, and weight, but not DBP
						NT	R: NR C: 11 W: NR		

Table H1. Characteristics of clinical trials of meditation practices in hypertension (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Patel CH, 1985[218] United Kingdom	RCT parallel 2 arms Duration: 8 wk8 mo4 yr ITT: NR	35-64 yr F = 74 M = 118 Mild HT (BP>140/90 mm Hg)	R: 204 C: 192 W: 12	Composite RR + BE + PMR	R: 107 C: 99 W: 8	HE	R: 97 C: 93 W: 4	Primary: BP changes (SBP, DBP), TC Secondary: smoking, morbidity, mortality	There was a significantly greater reduction in SBP, DBPand smoking in the intervention group compared to the control at 8 wk and 8 mo No significant differences in TC were found between the groups Differences in BP between groups were maintained at 4-yr followup Incidence of IHD and MI was significantly greater in the control group at 4- yr followup
Patel CH, 1975[219] United Kingdom	RCT parallel 2 arms Duration: 6 wk ITT: NR	59 yr F = 21 M = 13 Essential HT (DBP ≥110 mm Hg)	R: 36 C: 34 W: 2	Composite Yoga + BF	R: 18 C: 17 W: 1	Rest	R: 18 C: 17 W: 1	Primary: BP changes (SBP, DBP)	There was a significantly greater reduction in SBP and DBP in the intervention group compared with the control

Table H1. Characteristics of clinical trials of meditation practices in hypertension (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Schneider RH, 1995[79,221,232] United States	RCT parallel 3 arms Duration: 3 mo ITT: yes	66.8 yr F = 64 M = 47 Mild HT (SBP ≤ 189 mm Hg and DBP 90-109 mm Hg)	R: 127 C: 111 W: 16	Single TM®	R: 40 C: 36 W: 4	PMR	R: 42 C: 37 W: 5	Primary: BP changes (SBP, DBP) Secondary: compliance	TM® was was approximately twice as effective as PMR in controlling BP
						HE	R: 45 C: 38 W: 7		
Schneider RH, 2005[220] United States	RCT parallel 3 arms Duration: 1 yr ITT: yes	48.5 yr F = 79 M = 71 Mild to moderate HT (SBP 140-179 or DBP 90-109 mm Hg)	R: 197 C: 150 W: 47	Single TM®	R: 65 C: 54 W: 11	PMR	R: 68 C: 52 W: 16	Primary: BP changes (SBP, DBP) Secondary: change in AHM	TM® significantly decreased DBP more than PMR or HE, and there was a trend for a greater reduction in SBP There was a significant reduction in AHM use in the TM® group compared with PMR and HE
						HE	R: 64 C: 44 W: 20		
Seer P, 1980[222] New Zealand	RCT parallel 3 arms Duration: 3 mo ITT: NR	43.3 yr F = 18 M = 23 Essential HT (DBP ≥ 100 mm Hg)	R: 41 C: 36 W: 5	Single SRELAX (technique modeled after TM®)	R: 14 C: 12 W: 2	PLB	R: 14 C: 11 W: 3	Primary: BP changes (SBP, DBP)	There were modest reductions in blood pressure in both TM® and placebo groups (identical training but without a mantra)
						WL	R: 13 C: 13 W: 0		

Table H1. Characteristics of clinical trials of meditation practices in hypertension (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Selvamurthy W, 1998[226] India	NRCT parallel 2 arms Duration: 3 wk ITT: NR	41.7 yr F = 0 M = 20 Essential HT (SBP>140 mm Hg and DBP >90 mm Hg)	E: NR C: 20 W: NR	Single Yoga	E: NR C: 10 W: NR	Orthostatic tilt	E: NR C: 10 W: NR	Primary: BP changes (SBP, DBP) Secondary: AI-EEG, CO, HR, NE, EPI, PRA, urine K, urine Na, CPR	Both Yoga and orthostatic tilt restored BP to normal level Both interventions dropped CO, HR, CPR, NE, EPI, PRA and increased AI-EEG
Stone RA, 1976[227] United States	NRCT parallel 2 arms Duration: 6 mo ITT: NR	28 yr F = 2 M = 17 Mild to moderate HT (DBP > 105 mm Hg)	E: NR C: 19 W: NR	Single Zen Buddhist meditation	E: NR C: 14 W: NR	BP checks	E: NR C: 5 W: NR	Primary: BP changes (SBP, DBP) Secondary: changes in plasma DBH, plasma volume, PRA	Meditation significantly improved BP control in certain patients with mild or moderate HT PRA levels were significantly lower in the meditation group No differences in PRA and plasma were found
Surwit RS, 1978[228] United States	NRCT parallel 3 arms Duration: 6 wk ITT: NR	46.4 yr F = 5 M = 19 BHT (SBP ≥ 140 mm Hg or DBP ≥ 90 mm Hg)	E: NR C: 24 W: NR	Single RR	R: NR C: 8 W: NR	BF (EMG) BF (BP)	E: NR C: 8 W: NR E: NR C: 8 W: NR	Primary: BP changes (SBP, DBP)	All groups showed moderate reductions in BP No technique produced a reduction in BP greater than baseline values

Table H1. Characteristics of clinical trials of meditation practices in hypertension (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Tsai JC, 2003[223] Taiwan	RCT parallel 2 arms Duration: 12 wk ITT: NR	52 yr F = 38 M = 38 Borderline and Mild HT (SBP 130-159 mm Hg or DBP 85 -99 mm Hg)	R: 88 C: 76 W: 12	Single Tai Chi	R: 44 C: 37 W: 7	NT	R: 44 C: 39 W: 5	Primary: BP changes (SBP, DBP) Secondary: HR, TC, HDL-C, LDL-C, TG, BMI, anxiety	Tai Chi decreased blood pressure produced favorable lipid profile changes and improved anxiety status in subjects with mild hypertension
van Montfrans GA, 1990[224] Netherlands	RCT parallel 2 arms Duration: 1 yr ITT: NR	41.4 yr F = 17 M = 18 Mild HT (SBP 160-200 mm Hg and/or DBP 95-119 mm Hg)	R: 42 C: 35 W: 7	Composite Yoga + RR + PMR + AT	R: 23 C: 18 W: 5	Rest	R: 19 C: 17 W: 2	Primary: BP changes (SBP, DBP) Secondary: body weight, urine Na, TC	No relevant changes in BP or other parameters were found both in the intervention and the control groups
Yen LL, 1996[225] China	RCT parallel 4 arms Duration: 2 mo ITT: NR	54.5 yr F = 107 M = 192 Mild to moderate HT (SBP ≥ 140 mm Hg or DBP ≥ 90 mm Hg)	R: 392 C:299 W: 93	Composite Zen Buddhist meditation + PMR	R: NR C: 56 W: NR	BP checks	R: NR C: 64 W: NR	Primary: BP changes (SBP, DBP)	Zen Buddhist meditation + PMR, BP checks, and HE were significant and similarly effective in reduction of SBP compared with the NT group
						HE	R: NR C: 69 W: NR		
						NT	R: NR C: 110 W: NR		

Table H2. Characteristics of clinical trials of meditation practices in cardiovascular diseases

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Ades PA, 2005[233,253] United States	RCT 2 arms Duration: 6 mo ITT: NR	72.7 yr F = 42 M = 0 CHD	R: 51 C: 42 W: 9	Composite Yoga + BE	R: NR C: 21 W: NR	Resistance training	R: NR C: 21 W: NR	Primary: TEE Secondary: body strength, body weight, BMI, fat free mass, left ventricular function, VO_2 max, depression	Resistance training was associated with significant increases in upper and lower body strength, but no change in fat-free mass or left ventricular function Women in the Yoga group showed no changes in TEE There were no differences between groups in body composition, aerobic capacity or measures of depression

AMI = acute myocardial infarction; BE = breathing exercises; BNP = B-type natriuretic peptide; BMI = body mass index; BP = blood pressure; C = number completed; CABS = coronary artery bypass surgery; CAD = coronary artery disease; CHD = coronary heart disease; CHF = chronic heart failure; CRT = cognitive restructuring training; d = day(s); DBP = diastolic blood pressure; E = number enrolled (for NRCTs) GSH = glutathione; HDL-C = high-density lipoprotein cholesterol; HE = health education; HRQL = health-related quality of life; HRV = heart rate variability; ITT = intention to treat; LDL-C = low density lipoprotein cholesterol; LLM = lowering lipid medication; LVEF = left ventricular ejection fraction; LVDDi = left ventricular end diastolic volume index; min = minute(s); mo = month(s); NRCTs = nonrandomized controlled trial; MBSR = mindfulness-based stress reduction; NA = not applicable; NE = norepinephrine; NR = not reported; NS = not specified; NT = no treatment; NYHA = New York Heart Association; P-MDA = plasma malondialdehyde; PMR = Progressive muscle relaxation; PVD= peripheral vascular disease; PR = pulse rate; R = number randomized (for RCTs) SBP = systolic blood pressure; TC = total cholesterol; TEE = total energy expenditure; TG = triglycerides; TM® = Transcendental Meditation®; VE/VCO_2 = rate of increase of ventilation per unit of increase of carbon dioxide production; VO_2 max = maximum oxygen consumption; UC = usual care; VLDL-C = very low density lipoprotein cholesterol; W = number withdrawals/losses to followup; wk = week(s); WL = waiting list; WR = work rate; yr = year(s)

Table H2. Characteristics of clinical trials of meditation practices in cardiovascular diseases (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Chang BH, 2005[234] United States	RCT parallel 3 arms Duration: 19 wk ITT: yes	69.2 yr. F = 1 M = 94 CHF	R: 95 C: 83 W: 12	Single RR	R: 34 C: 31 W: 3	HE	R: 32 C: 24 W: 8	Primary: HRQL Secondary: VO_2 max	The RR group had significantly better HRQL change scores in peace-spiritual scales than did the UC. No significant difference was observed between the HE and UC groups No statistically significant intervention effect on physical HRQL or exercise capacity was observed
						UC (NS)	R: 29 C: 28 W: 1		
Channer KS, 1996[235] United Kingdom	RCT parallel 3 arms Duration: 8 wk ITT: NR	56 yr F = 36 M = 90 AMI	R: 126 C: 104 W: 22	Single Tai Chi	R: 38 C: 31 W: 7	Exercise	R: 41 C: 30 W: 11	Primary: BP changes (DBP, SBP) Secondary: HR	There was a significant greater reduction in DBP in the Tai Chi group than in the exercise group Significant trends in SBP occurred for both Tai Chi and exercise groups Tai Chi was associated with a greater HR reduction than exercise
						HE	R: 47 C: 43 W: 4		
Curiati JA, 2005[236] Brazil	RCT parallel 2 arms Duration: 12 wk ITT: NR	74.7 yr F = 14 M = 5 CHF	R: 19 C: 15 W: 4	Composite RR + BE	R: 10 C: 8 W: 2	Group therapy	R: 9 C: 7 W: 2	Primary: NE Secondary: HRQL, VE/VCO_2 slope, VO_2, LVEF, LVDDi	RR + BE significantly reduced NE, VE/VCO_2 slope, and improved HRQL No changes occurred in LVEF, LVDDi, or VO_2

Table H2. Characteristics of clinical trials of meditation practices in cardiovascular diseases (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Friedman NL, 2002[237] United States	RCT parallel 2 arms Duration: 90 min ITT: NR	63 yr F = 9 M = 47 CAD	R: 67 C: 56 W: 11	Single Zen Buddhist meditation	R: NR C: 28 W: NR	HE	R: NR C: 28 W: NR	Primary: HRV	Meditation singnificantly increased HRV compared with HE
Hipp A, 1998[247] Germany	NRCT parallel 2 arms Duration: 6 mo ITT: NR	64 yr F = 7 M = 19 CAD	E: NR C: 26 W: NR	Single Yoga	E: NR C: 20 W: NR	NT	E: NR C: 6 W: NR	Primary: TC Secondary: HDL-C, LDL-C, VLDL-C, TG	Yoga significantly reduced TC No significant effect on HDL-C, VLDL-C and TG was found
Jatuporn S, 2003[238] Thailand	RCT parallel 2 arms Duration: 4 mo ITT: NR	59 yr F = 9 M = 35 CAD	R: 44 C: 44 W: 0	Composite Yoga + intensive lifestyle modifica-tion program	R: 22 C: 22 W: 0	LLM	R: 22 C: 22 W: 0	Primary: total anti-oxidant status, vitamin C, vita-min E Secondary: TG, TC, HDL-C, LDL-C, P-MDA, erythrocyte GSH, BMI	Yoga + intensive lifestyle modification produced a signiificant increase in TC, HDL-C and decrease in TG and BMI Total antioxidant status, vitamin E and erythrocyte GSH were also increased There were no significant changes in P-MDA and vitamin C

Table H2. Characteristics of clinical trials of meditation practices in cardiovascular diseases (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Lan C, 1999[248] Taiwan	NRCT parallel 2 arms Duration: 1 yr ITT: NR	56.5 yr F = 0 M = 27 CABS	E: 27 C: 20 W: 7	Single Tai Chi	E: 12 C: 9 W: 3	Exercise	E: 15 C: 11 W: 4	Primary: peak VO_2, Secondary: peak WR, HR	The Tai Chi group showed significant improvement in a 1-yr TCC program for low cardiorespiratory function
Mahajan AS, 1999[239] India	RCT parallel 2 arms Duration: 14 wk ITT: NR	56-59 yr F = 0 M = 93 CAD	R: 93 C: NR W: NR	Composite Yoga + diet changes	R: 52 C: NR W: NR	Exercise + Diet change s	R: 41 C: NR W: NR	Primary: body weight, lipid profile (TC, HDL-C, LDL-C)	There were changes in body weight and lipid profile in both the control and intervention groups. However, the pattern of change was inconsistent in the controls
Manchanda SC, 2000[240] India	RCT parallel 2 arms Duration: 1 yr ITT: NR	51.5 yr F = 0 M = 42 CAD	R: 42 C: NR W: NR	Composite Yoga + diet + aerobic exercise	R: 21 C: NR W: NR	Exercise + diet change s	R: 21 C: NR W: NR	Primary: number of angina episodes/wk, lesion severity, NYHA functional class Secondary: exercise capacity, body weight, TC, HDL-C, LDL-C, TG	Yoga lifestyle intervention significantly improved NYHA functional class and reduced the number of angina episodes Yoga significantly decreased body weight, TC, LDL-C and TC. No changes were observed for HDL-C Yoga improved exercise duration and reduction in the degree of ST segment depression

Table H2. Characteristics of clinical trials of meditation practices in cardiovascular diseases (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Mandle CL, 1988[91,254] United States	RCT parallel 3 arms Duration: NR ITT: NR	59.8 yr F = 28 M = 17 PVD	R: 45 C: 45 W: 0	Single RR	R: 15 C: 15 W: 0	Rest (1) Listening music	R: 14 C: 14 W: 0	Primary: anxiety, pain Secondary: medication use, HR, BP changes (DBP, SBP), PR	Patients in the RR group had significantly less anxietypainand medication use than both the music and blank tape groups
						Rest (2) Listening blank tapes	R: 16 C: 16 W:0		
Pool JI, 1995[241] United States	RCT parallel 3 arms Duration: 9 wk ITT: NR	59.2 yr F = 36 M = 16 CHD	R: 50 C: 35 W: 15	Single Mindfulness meditatio n (NS)	R: 16 C: 10 W: 6	CRT	R: 13 C: 9 W: 4 11	Primary: BP changes (DBP, SBP) Secondary: HR, anxiety, depression, psychological distress, irritability, hostility	No statistically significant differences were found among mindfulness meditation, CRTand group therapy groups for any of the outcomes
						Group therapy	R: 21 C: 16 W: 5		
Quillian-Wolever RE, 2005[242] United States	RCT parallel 2 arms Duration: 10 mo ITT: NR	Age NR F = NR M = NR CHD	R: 154 C: NR W: NR	Composite Mindfulness medita-tion (NS) + HE + health coaching	R: NR C: NR W:NR	UC (NS)	R: NR C: NR W:NR	Primary: coronary heart disease risk at 10 years	The treatment group demonstrated improvement in 10-yr risk compared with usual care

Table H2. Characteristics of clinical trials of meditation practices in cardiovascular diseases (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population		Intervention		Comparison groups		Outcomes	Authors' conclusions
		Age (mean/range), gender, diagnosis	N participants	Type/name	N participants	Type/name	N participants		
Stenlund T, 2005[243] Sweden	RCT parallel 2 arms Duration: 3 mo ITT: NR	77.4 yr F = 29 M = 66 CAD	R: 109 C: 95 W: 14	Composite Qi Gong + discussion s	R: 56 C: 48 W: 8	HE	R: 53 C: 47 W: 6	Primary: level of physical activity Secondary: balance, coordination, fear of falling	Qi Gong significantly improved the level of physical activity and coordination No significant differences were found between the groups regarding fear of falling and balance
Tacon AM, 2003[244,255] United States	RCT parallel 2 arms Duration: 8 wk ITT: NR	60.3 yr F = 18 M = 0 CAD	R: 20 C: 18 W: 2	Single MBSR	R: 10 C: 9 W: 1	WL	R: 10 C: 9 W: 1	Primary: anxiety Secondary: coping styles, emotional control, health locus of control, cortisol[255] breathing frequency,[255] total catecholamines[255] BP changes (DBP, SBP), HRQL	There were significant differences between the MBSR and control groups on scores of anxiety, emotional control, coping, ventilation, and breathing frequency MBSR had no effect on health locus of control, cortisol, or physical functioning

Table H2. Characteristics of clinical trials of meditation practices in cardiovascular diseases (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Tsai SL, 2004[249] China	NRCT parallel 2 arms Duration: 1 yr ITT: NR	63.2 yr F = 13 M = 87 CAD	E: 146 C: 100 W: 46	Composite Mindfulness meditation (NS) + BE + PMR + imagery	E: 67 C: 41 W: 26	UC (NS)	E: 79 C: 59 W: 20	Primary: anxiety Secondary: sleep, relaxation level	The composite intervention significantly improved anxiety, sleep, and relaxation when compared with the control group
Williams KA, 2001[245] United States	RCT parallel 2 arms Duration: 12 wk ITT: NR	Age NR F = NR M = NR CAD	R: 35 C: NR W: NR	Single MBSR	R: 11 C: NR W: NR	NT	R: 24 C: NR W: NR	Primary: depression Secondary: anger, anxiety, hostility, vitality, mental health	MBSR produced significant reductions in depression, anger expression, and hostility. It also increased general health, vitality and mental health
Yeh GY, 2004[246,256] United States	RCT parallel 2 arms Duration: 12 wk ITT: Yes	64 yr F = 11 M = 19 CHF	R: 30 C: 26 W: 4	Single Tai Chi	R: 15 C: 15 W: 0	Medication (NS)	R: 15 C: 12 W: 3	Primary: HRQL, exercise capacity Secondary: BNP, plasma catecholamines, VO_2 max	Patients in the Tai Chi group improved HRQL, increased distance walked in 6 min, and decreased BNP levels compared with the control group. A trend towards improvement was seen in VO_2 max No differences were detected in catecholamine levels

Table H2. Characteristics of clinical trials of meditation practices in cardiovascular diseases (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Yogendra J, 2004[250] India	NRCT parallel 2 arms Duration: 1 yr ITT: NR	Age NR F = NR M = NR CAD	E: 140 C: 113 W: 27	Composite Yoga + risk factors control + diet + stress manage-ment	E: 80 C: 71 W: 9	Medication (NS)	E: 60 C: 42 W: 18	Primary: TC, LDL-C Secondary: clinical improvement, caloric intake, regression of disease, anxiety, depression, myocardial perfusion	Significant changes were found in TC, LDL-C, regression of disease in the Yoga group Differences between the groups on anxiety and depression were not statistically significant
Young JW, 2001[251] United States	NRCT parallel 2 arms Duration: 6 wk ITT: NR	63 yr F = 13 M = 21 CHD	E: 44 C: 34 W: 10	Single Yoga	E: 27 C: 17 W: 10	NT	E: 17 C: 17 W: 0	Primary: anxiety Secondary: somatization, tension, depression, global status, mood disturbances	The treatment group showed significantly greater improvement in anxiety, somatization, depression, tension, anger, global status, and mood Inequities in baseline scores preclude atttributing improvement to Yoga except on somatization

Table H2. Characteristics of clinical trials of meditation practices in cardiovascular diseases (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Zamarra JW1996[252, 257] United States	NRCT parallel 2 arms Duration: 8 mo ITT: NR	55 yr F = 0 M = 21 CAD	E: 21 C: 16 W: 5	Single TM®	E: 12 C: 10 W: 2	WL	E: 9 C: 6 W: 3	Primary: Exercise tolerance Secondary: Maximal workloadST depression onsetrate-pressure product	Compared with the control groupthe the patients who learned TM® demonstrated significantly greater exercise tolerancehigher maximal workloaddelayed onset of ST segment depressionand decreases in double product at each exercise interval

Table H3: Characteristics of clinical trials of meditation practices in substance abuse

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Alterman AI, 2004[258] United States	RCT parallel 2 arms Duration: 5 mo ITT: NR	36.5 yr F = 17 M = 14 Alcohol and drug abuse (cocaineheroin)	R: 31 C: 25 W: 6	Single Mindful-ness medita-tion (NS)	R: 18 C: 15 W:3	UC (NS)	R: 13 C: 10 W:3	Primary: addiction severity Secondary: medical problems, positive mood, positive health, personal meaning, optimism-pessimism, spirituality	There is relatively little indication that mindfulness meditation enhanced treatment outcomes for substance abuse patients
Ballou D, 1977[259] United States	RCT parallel 3 arms Duration: 11 wk ITT: NR	Age NR F = 0 M = 66 Drug dependency	R: 66 C: NR W: NR	Single TM®	R: 30 C: NR W: NR	WL	R: 20 C: NR W: NR	Primary: anxiety Secondary: behavioral changes, inmate infractions	TM® significantly decreased anxiety, frequency of inmate infractions, and increase the number of hours of recreational and educational activities
						NT	R: 16 C: NR W: NR		

5-HIAA = 5-hydroxyindole acetic acid; 17-KS = 17-ketosteroids; BE = breathing exercises; BF = biofeedback; BP = blood pressure; C = number completed; CRT = cognitive restructuring training; CSM = clinically standardized meditation; d = day(s); DBP = diastolic blood pressure; E = number enrolled (for NRCTs); EMG = electromyography; ESR = erythrocyte sedimentation rate; GSR = galvanic skin response; Hb = hemoglobin; HR = heart rate; HVA = homovanillic acid; ITT = intention to treat; LFPMF = low-frequency pulsed magnetic field; LSD = lysergic acid diethylamide; MBSR = mindfulness-based stress reduction; MHPG = 3-methoxy-4-hydroxyphenylglycol; mo = month(s); NRCT = nonrandomized controlled trial; NR = not reported; NS = not specified; PBI = protein bound iodine; PMR = progressive muscle relaxation; PR = pulse rate; PT = prothrombine time; R = number randomized (for RCTs); RR = Relaxation Response; SBP = systolic blood pressure; S-Ca = serum calcium; S-Mg = serum magnesium; TM® = Transcendental Meditation®; VO_2 max = maximum oxygen consumption; UC = usual care; VMA = vanillylmandelic acid; W = number withdrawals/losses to followup;WBC = white blood cell; wk = week(s); yr = year(s)

Table H3: Characteristics of clinical trials of meditation practices in substance abuse (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Barton MJ, 2004[260] United States	RCT parallel 2 arms Duration: 1 d ITT: NR	Age NR F = 4 M = 6 Alcohol abuse	R: 10 C: NR W:NR	Single Medical meditation (mantra + BE)	R: 5 C: NR W: NR	Rest (music)	R: 5 C: NR W: NR	Primary: BP changes (DBP, SBP) Secondary: PR, GSR, spirituality	There were no significant changes in BP, GSR, or spirituality after practicing medical meditation as compared with the control group
Brautigam E, 1977[261] Sweden	RCT parallel 2 arms Duration: 6 mo ITT: NR	17-24 yr F = 6 M = 14 Alcohol and drug abuse (marijuana, hashish, LSD, amphetamines)	R: 20 C: NR W: NR	Single TM®	R: 10 C: NR W: NR	Group therapy	R: 10 C: NR W: NR	Primary: frequency of drug use Secondary: leisure activity, self-confidence, anxiety, psychomotor retardation	Meditators showed a marked decrease in drug use, whereas control subjects maintained high usage level Meditators showed an increase in level of self-acceptance, satisfaction, ability to adjust and a decrease in anxiety
Kline KS, 1982[271] United States	NRCT parallel 2 arms Duration: 12 wk ITT: NR	34.7 yr F = 9 M = 14 Alcohol abuse	E: 23 C: 8 W: 15	Single TM®	E: 11 C: 7 W: 4	WL	E: 12 C: 8 W: 4	Primary: personality profile Secondary: self-actualization	There were no significant changes in global personality or self-actualization in the intervention and control groups
Li M, 1956[262] China	RCT parallel 3 arms Duration: 10 days ITT: NR	32.3 yr F = 0 M = 86 Drug abuse (heroin)	R: 86 C: NR W: NR	Single Qi Gong	R: 34 C: NR W: NR	Lofexidine	R: 26 C: NR W: NR	Primary: withdrawal symptoms Secondary: anxiety, urine morphine	Qi Gong significantly reduced withdrawal symptoms, anxietyand shortened recovery time
						NT	R: 26 C: NR W: NR		

Table H3: Characteristics of clinical trials of meditation practices in substance abuse (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Marcus MT, 2001[272,275] United States	NRCT parallel 2 arms Duration: 8 wk ITT: NR	34 yr F = 2 M = 34 Alcohol and drug abuse	E: 36 C: NR W: NR	Single MBSR	E: 18 C: NR W: NR	NT	E: 18 C: NR W: NR	Primary: coping styles Secondary: psycho-pathology symptoms	There were no significant changes in coping styles and psychopathology symptoms resulting from the MBSR intervention when compared with a control group
Murphy R, 1995[263] United States	RCT parallel 2 arms Duration: 1 month ITT: NR	32.7 yr F = 0 M = 31 Alcohol and drug abuse	R: 31 C: 27 W: 4	Single MBSR	R: 15 C: 13 W: 2	PMR	R: 16 C: 14 W: 2	Primary: ego-centrism Secondary: anger, im-pulsivity, cortisol levels	Reductions in self-reported anger in the MBSR and PMR groups were not significantly different from each other. No significant differences were found among groups for measures of egocentrism, impulsivity and cortisol levels
Murphy TJ, 1986[264] United States	RCT parallel 3 arms Duration: 8 wk ITT: NR	24.7 yr F = 0 M = 43 Alcohol abuse	R: 60 C: 43 W: 17	Single CSM	R: 20 C: 14 W: 6	Exercise	R: 20 C: 13 W: 7	Primary: alcohol consump-tion Secondary: VO_2 max	There were no significant differences in alcohol consumption or VO_2 max between CSM and either exercise or NT groups Subjects in the exercise condition significantly reduced their alcohol consumption
						NT	R: 20 C: 16 W: 4		

Table H3: Characteristics of clinical trials of meditation practices in substance abuse (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Parker JC, 1978[265,276,277] United States	RCT parallel 3 arms Duration: 3 wk ITT: NR	45.1 yr F = 0 M = 30 Alcohol abuse	R: 30 C: 30 W: 0	Single RR	R: 10 C: 10 W: 0	PMR Rest	R: 10 C: 10 W: 0 R: 10 C: 10 W: 0	Primary: anxiety Secondary: BP changes (DBP, SBP), HR, GSR, tension	The results revealed generalized effects for BP, but not for the other outcome measures The RR and PMR groups did not exhibit increased BP as observed in control subjects RR and PMR produced significant changes in tension
Raina N, 2001[266] India	RCT parallel 2 arms Duration: 24 wk ITT: NR	34.9 yr F = 0 M = 50 Alcohol abuse	R: 50 C: 27 W: 23	Single Yoga	R: 25 C: 13 W: 12	Exercise	R: 25 C: 14 W: 11	Primary: recovery rate	Yoga produced significantly greater recovery rate compared with exercise
Ramirez J, 1990[267] United States	RCT parallel 2 arms Duration: NR ITT: NR	23.3 yr F = 40 M = 40 Drug abuse	R: 80 C: 68 W: 12	Single TM®	R: 40 C: NR W: NR	Control (NS)	R: 40 C: NR W: NR	Primary: self-concept Secondary: emotional stability, maturity, hostility, over-concern with physic-cal symp - toms	TM® produced greater emotional stability and maturity and an improved self-concept while showing a decrease in aggressive tendencies and a lessened concern with physical symptoms

Table H3: Characteristics of clinical trials of meditation practices in substance abuse (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Rohsenow DJ, 1985[268] United States	RCT parallel 2 arms Duration: 6 mo ITT: NR	21.3 yr F = 0 M = 36 Heavy social drinkers	R: 40 C: 36 W: 5	Composite RR + PMR + CRT	R: NR C: 15 W: NR	Control (NS)	R: NR C: 21 W: NR	Primary: anxiety Secondary: anger, depression, alcohol consump-tion, locus of control, irrational beliefs	There is a modest and transitory overall success in modifying mood, cognition, and alcohol comsumption of heavy social drinkers through stress management training that incorporates the RR
Shaffer HJ, 1997[269] United States	RCT parallel 2 arms Duration: 6 mo ITT: NR	35.9 yr F = 24 M = 35 Drug abuse	R: 59 C: NR W: NR	Composite Yoga + methadone	R: 29 C: NR W: NR	Group therapy + metha-done	R: 30 C: NR W: NR	Primary: addiction severity Secondary: psychological symptoms	There were no significant differences between a group therapy and Yoga for enhancing methadone maintenance treatment

Table H3: Characteristics of clinical trials of meditation practices in substance abuse (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Subrahmanyam S, 1986[273] India	NRCT parallel 5 arms Duration: 1 yr ITT: NR	20-45 yr F = 0 M = 100 Alcohol abuse	E: 100 C: NR W: NR	Single Yoga	E: 20 C: NR W: NR	Psychotherapy	E: 20 C: NR W: NR	Primary: clinical status Secondary: psychological status, WBC count, ESR, blood glucose, TC, cortisol, lactic acid, PBI, 5-HIAA, Hb, catecholamines, S-Ca, S-Mg, VMA, HVA, 17-KS, PT, MHPG, cholinesterase	Improvement was noticed in all the intervention groups for the outcomes tested LFPMF seems to be more effective for improving clinical status
						Stereotaxic surgery	E: 20 C: NR W: NR		
						BF	E: 20 C: NR W: NR		
						LFPMF	E: 20 C: NR W: NR		

Table H3: Characteristics of clinical trials of meditation practices in substance abuse (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Taub E, 1994[270] United States	RCT parallel 3 arms Duration: 18 mo ITT: NR	44.3 yr F = 0 M = 67 Alcohol abuse	R: NR C: 67 W: NR	Single TM®	R: NR C: 18 W: NR	BF (EMG)	R: NR C: 13 W: NR	Primary: drinking days Secondary: complete abstinence, mood states	TM® and BF (EMG) groups exhibited significant increases in percent of non-drinking days Both interventions were associated with greater abstinence rates and mood improvement
						Neuro-therapy	R: NR C: 18 W: NR		
						Counselling	R: NR C: 18 W: NR		

Table H3: Characteristics of clinical trials of meditation practices in substance abuse (continued)

Study, country	Study design, followup duration, ITT	Characteristics of study population: Age (mean/range), gender, diagnosis	Characteristics of study population: N participants	Intervention: Type/name	Intervention: N participants	Comparison groups: Type/name	Comparison groups: N participants	Outcomes	Authors' conclusions
Wong MR, 1981[274] United States	NRCT parallel 2 arms Duration: 6 mo ITT: NR	28.9 yr F = 0 M = 103 Drug abuse	E: 103 C: 91 W: 12	Composite Meditation practice (NS)	E: NR C: 52 W: NR	Relaxation	E: NR C: 39 W: NR	Primary: physical tension Secondary: anxiety, personality changes	Meditation significantly increased the ability to control muscle relaxation, improve the level of self awareness as compared with the control group The failure to detect any positive change at 6-mo. followup indicates that effects were not strong enough to be detected over time

Appendix I. Characteristics of Studies Included in Topic V

Table I1. Country of study

	Country	N	References
North America	United States	146	126,177,205,206,208,233,234,260,279,280,289,290,304,311,387,440,442,459,460,463,468,475,477,478,480,483,489,491,494b127,197,306,500,503a306b91,94,134,168,178,181,188,190,198,209, 210,220,221,227,228,237,241,244,263-265,272,282,284,285,288,292,293,309,316,317,319,322,325,391,396,398,407,409,418,419,433,510,512,517-519,21,524,525,528,530,531 ,536,539,541 ,544,545,554,558,559,562,567,577,594,596,602,603,608,615,616,618,625-627,634,639,642,651-654,665,666,677,678,681,683,696,697,706,713,714,733 ,746,750,751,753,754a,754b78,191, ,246 ,252,274,287,397,435,759,764,766
	Canada	9	97,182,194,296,386,413,777,782,793
Asia	India	71	83,133,137,140,204,212,217,226,239,240,250,273,278,294,295,298,300,301,303,305,310,312-314,318,320,321,323,417,794,796,797,799,801,802,805,806,811-815,818,822,824,829,831,832,834,836-839,841,843,844,847,848,850-852,856,858,860,862-864,866-868,870
	China	8	211,225,262,872,875,878,882,883
	South Korea	6	213,214,405,889,891,894
	Hong Kong	5	207,286,299,895,897
	Taiwan	4	223,248,326,906
	Japan	7	389,426,913-916,919
	Thailand	3	106,216,238
	Malaysia	2	179,180
Europe	United Kingdom	14	185,218,219,235,281,283,308,427,431,926,930,932,938,940
	Germany	4	215,247,943,946
	Sweden	2	302,955
	Norway	3	956,959,961
	Ireland	2	392,965
	Italy	1	966
	Switzerland	1	199
	Netherlands	1	224
	Spain	1	977
	Austria	1	430
	Czech Republic	1	183
	France	1	981
	Russia	1	203

Table I1. Country of study (continued)

Country		N	References
Europe (continued)	Turkey	2	[315,982]
Australasia	Australia	7	[297,307,991,992,998,999,1001]
	New Zealand	3	[222,429,1002]
Other	Israel	2	[176,291]
	South Africa	1	[86]
	Brazil	1	[236]
	Netherlands Antilles	1	[974]

Table I2. Study design

Study design	N	References
RCT	167	86,91,94,97,127,134,140,168,176,177,182,185,190,194,203-224,233-241,244,260,262-265,278-286,288,304,305,307-309,325,386,387,389,391,392,396,398,405,407,409,413,417,418,427,431,433,460,475,477,478,480,483,503,512,519,521,528,530,531,536,539,541,544,545,554,558,562,567,594,603,615,616,618,625-627,651,665,666,677,683,706,714,746,751,754,777,782,796,805,811,829,832,836-839,841,844,852,858,868,894,895,919,926,930,932,943,946,956,959,961,965,977,991,998,999a 754b 78,191,225,246,287,397,759,764,793,882,940
NRCT	65	126,289,290,440,463,489,494,794,799b 197,291,306,500a 306b 106,137,178-181,183,188,198,199,226-228,247,248,250,252,272-274,292,293,326,419,429,430,435,518,577,596,602,639,642,678,681,696,713,806,818,824,834,860,864,866,878,915,938,955,974,981,1001
Before-and-after	79	83,133,294-303,310-323,426,442,459,468,491,510,517,524,525,559,608,634,652-654,697,733,750,753,766,797,801,802,812-815,822,831,843,847,848,850,851,856,862,863,867,870,872,875,883,889,891,897,906,913,914,916,966,982,992,1002

NRCT = nonrandomized controlled trials; RCT = randomized controlled trials

Table I3. Type of publication

Type of publication	N	References
Journal article	274	176,177,203,204,206-208,233-235,278-281,289,290,295,297,304,305,310-312,387,440,459,460,463,468,475,477,478,480,483,489,491,494,794,796,797,799,801,802,895,966b 127,194,236,291,306,389,500,503a 306b 83,97,106,133,137,140,168,178-183,185,188,190,198,209,211-214,216-224,226-228,238-240,244,248,262,264,265,272,273,282-286,288,293,294,296,298-303,307-309,313-316,318-321,323,325,326,386,392,396,398,405,407,409,413,417-419,426,427,429,431,510,512,518,519,521,524,525,528,530,531,536,539,544,545,554,558,559,562,577,594,603,608,615,616,618,625-627,634,639,642,651-654,665,666,677,678,681,683,697,706,714,733,750,751,753,754,777,782,805,806,811-815,818,822,824,829,831,832,834,836-839,841,843,844,847,848,850-852,856,858,860,862-864,866-868,878,889,891,894,897,906,913-916,926,930,932,946,956,959,961,965,974,977,981,982,991,992,998,1002a 754b 191,199,225,246,250,252,274,287,397,435,759,764,766,793,870,938,940,955,1001
Thesis/Dissertation	22	78,86,91,126,134,197,205,210,237,241,260,263,292,391,433,442,517,541,567,602,696,882
Abstract	13	94,215,247,317,322,430,596,713,872,875,883,943,999
Research letter	2	746,919

Table I4 Methodological quality—intervention studies

RCTs—Jadad scale	RCTs that obtained Jadad scores lower than 3 (n=145) [94,97,134,140,176,177,182,185,190,194,203-219,222-224,233,235-241,244,260,262-265,278-281,283,285,286,288,304,305,307-309,325,387,389,392,396,405,407,413,417,418,427,431,433,460,475,477,478,480,483,503,512,519,528,530,531,536,539,545,554,558,562,567,594,603,615,616,618,625-627,651,665,666,677,683,706,714,746,751,754,777,782,796,805,811,829,832,836-838,841,844,852,858,868,895,919,926,930,932,943,946,956,959,961,965,977,998**a 754b 78,191,225,246,397,759,764,793,882,940**]
	RCTs that obtained Jadad scores of 3 or greater (n=22) [86,91,127,168,220,221,234,265,282,284,287,386,391,398,409,521,541,544,839,894,991,999]
	RCTs describing the methods of randomization (n=32) *Appropriate (n=24)* [86,91,127,168,206,220,221,234,260,265,282,284,287,308,386,391,398,409,521,541,544,811,839,894] *Inappropriate (n=8)* 134,212,213,262,478,545,841,868
	RCTs described as double-blind (n=5) [168,424,782,991,999]
	RCTs describing withdrawals/dropouts (n=86) [86,91,94,97,127,168,185,203,207,210,213,214,216,218-224,234-236,238,241,244,263-265,278-286,325,386,391,398,409,478,480,503,521,528,536,541,544,562,603,616,618,626,627,651,666,683,714,754,777,829,839,841,852,868,894,895,926,930,946,977,991,998,999a 754b78,246,287,759,764,793,882,940]
RCTs—concealment of treatment allocation	RCTs with adequate report of methods for concealment of allocation (n=8) [168,246,418,521,544,894,926,991]
	RCTs with inadequate report of methods for concealment of allocation (n=2) [545,868]
	RCTs that failed to describe the methods for concealment of allocation (n=157) [86,91,94,97,127,134,140,176,177,182,185,190,194,203-224,233-241,244,260,262-265,278-286,288,304,305,307-309,325,386,387,389,391,392,396,398,405,407,409,413,417,427,431,433,460,475,477,478,480,483,503,512,519,528,530,531,536,539,541,554,558,562,567,594,603,615,616,618,625-627,651,665,666,677,683,706,714,746,751,754,777,782,796,805,811,829,832,836-839,841,844,852,858,895,919,930,932,943,946,956,959,961,965,977,998,999a 754b 78,191,225,287,397,759,764,793,882,940]
Before-and-after studies	Before-and-after studies with study population representative of the target population (n=3) [294,697,847]
	Before-and-after studies in which the method of outcome assessment was the same for the pre- and post- intervention periods for all participants (n=74) [83,133,294-298,300-303,310,312-323,426,442,459,468,491,510,517,524,525,559,608,634,652-654,733,750,753,766,797,801,802,812-815,822,831,843,847,848,850,851,856,862,863,867,870,872,875,883,889,891,897,906,913,914,982,992,1002]
	Before-and-after studies in which outcome assessors were blind to intervention and assessment period (n=2) [654,753]
	Before-and-after studies that reported the number of study withdrawals (n=12) [295,296,442,525,559,733,753,797,801,814,851,897]
	Before-and-after studies that reported the reasons for study withdrawal (n=6) [442,525,559,733,801,897]

Table I5. Clinical trials and before-and-after studies on physiological and neuropsychological effects of meditation practices

Category of meditation practices	Meditation practice	N	Associated references
Mantra meditation (105)	ACEM meditation	3	956,959,961
	CSM	4	97,264,536,627
	Mantra meditation	17	203,260,483,494,706b194,503,531,577,626,652-654,777,805,856,965
	RR	34	208,234,236,304,306,459,460,475,477,480a 306b 91,94,191,209,218,228,265,283,284,288,396,521,524,525,530,558,567,594,616,625,678,753,938
	TM®	47	78,86,188,190,205,206,210,220-222,252,279,282,289,291-293,295,309,311,319,392,407,418,429,433,440,463,478,518,519,528,545,677,683,714,733,750,759,782,793,796,814,815,850,974,1002
Mindfulness meditation (44)	MBSR	12	244,263,272,419,512,517,602,681,697,754,930a 754b
	MM (NS)	8	106,241,386,430,442,696,751,932
	Zen Buddhist meditation	10	197,225,227,237,426,500,554,639,913,916
	MBCT	2	427,940
	Vipassana	2	847,848
Meditation practices (ND)		9	198,199,215,274,387,431,539,651,915
Qigong		15	207,211,213,214,262,299,316,405,634,875,889,891,914,919,977
Tai Chi		38	223,235,246,248,285-287,290,296,307,317,326,391,397,398,409,413,435,489,541,596,603,608,665,713,746,766,872,878,882,883,894,895,897,906,955,999,1001
Yoga		110	83,126,127,133,134,137,140,168,176-183,185,204,212,216,217,219,224,226,233,238-240,247,250,273,278,280,281,294,297,298,300-303,305,308,310,312-315,318,320-323,325,389,417,468,491,510,544,559,562,615,618,642,666,764,794,797,799,801,802,806,811-813,818,822,824,829,831,832,834,836-839,841,843,844,851,852,858,860,862-864,866-868,870,926,943,946,966,981,982,991,992,998

CSM = clinically standardized meditation; MBCT = mindfulness-based cognitive therapy; MBSR = mindfulness-based stress reduction; MM = mindfulness meditation; ND = not described; NS = not specified; RR = Relaxation Response; TM® = Transcendental Meditation ®

Table I6. Studies reporting outcome measures on the physiological and neuropsychological effects of meditation practices

Domain	Category	Subcategory	N	Studies reporting outcome measure
Physio-logical	Blood system (15)	Blood composition	11	213,273,302,309,320,746,794,843,919,926,977
		Blood enzyme	4	273,313,862,863
	Cardiovascular system (186)	Blood gas measurement	8	233,296,320,524,813,839,891,998
		Cardiovascular functioning	169	213,246,250,296,297,321,426,811,906 83,106,140,185,190,199,206,208,214,217,218,221,223,224,226,235,248,252,264,280-283,286,294,299,306,307,316,323,326,326,392,396,429,480,521,525,536,562,651,733,753,777,796,813,822,834,838,838,851,852,856,858,858,894,914,916,961,966,9821306286,91,94,97,126,127,134,180,194,197,203-205,207,209-212,215,216,219,220,222,225,227,228,234,236,237,241,244,260,265,278,279,284,285,287-292,295,302-305,309-313,317,319,320,322,387,389,391,433,435,442,459,460,475,483,491,510,517,524,528,530,531,539,541,577,608,616,627,652,677,696,714,806,831,839,844,862,872,883,897,915,926,932,956,998,1002
		Energy expenditure	2	233,491
		Physical performance	7	240,246,391,397,409,666,813
	Digestive system (26)	Gastric function	1	852
		Lipoproteins	25	205-207,213,218,223,238-240,247,250,273,278,280,282,291,292,302,313,317,794,801,850,926,1002
	Endocrine system (62)	Adrenocortical functioning	26	106,207,214,226,236,244,246,263,272,273,283,299,307,313,386,405,407,417,419,433,651,764,806,850,862,955
		Carbohydrate metabolism	18	273,278,282,298,301,308,313,317,321,391,405,794,801,850,862,914,961,999
		CNS hormone	11	211,246,313,386,405,407,433,806,811,889,956
		Genital gland secretion	1	433
		Parathyroid function	4	273,407,713,889
		Thyroid function	2	836,889
	Immune system (14)	Cellular immunity	7	386,405,419,642,843,959,977
		Humoral immunity	7	299,386,398,512,558,697,977

CNS = central nervous system; EMG = electromyography

Table I6. Studies reporting outcome measures on the physiological and neuropsychological effects of meditation practices (continued)

Domain	Category	Subcategory	N	Studies reporting outcome measure
Physio-logical	Musculoskeletal system (35)	Body index	2	391,559
		Bone density test	6	280,596,713,872,895,1001
	EMG		23	190,199,306,392,766,837a 306b 290,503,531,577,626,627,683,847,965 191,228,274,477,639,844,882
	Isometric contraction		3	413,489,872
	Reflex test		1	750
	Nervous system (63)	Autonomic functioning	1	852
		Brain electrophys-iology	17	133,226,417,426,512,519,545,594,627,634,706,733,805,814,815,913,916
		Neuroendocrine measurement	7	227,273,407,433,806,850,863
		Peripheral nerve test	40	754a 83,140,190,199,226,294,306,323,392,417,544,545,733,777,796,824,856,858,981a 306b 188,204,260,265,288,312,440,463,477,478,483,531,577,627,652,844,847,848,938
	Nutrition/metabolism (32)	Antioxidants	3	137,238,799
		Cell metabolism	1	281
		Metabolic product	16	137,262,273,313,320,417,653,713,746,799,806,834,838,844,862,870
		Salivary test	2	198,654
		Serum protein	6	106,227,273,313,850,862
	Ocular system (4)	Ophthalmologic test	4	176,297,315,625
	Respiratory system (68)	Pulmonary function test	68	83,106,140,168,190,199,214,248,280,294,296,300,306,314,316,321,323,325,326,429,468,521,733,797,802,811,813,829,832,834,843,856,858,868,966,981,991a 306b 86,94,183,236,244,288,309,310,312,313,320,442,510,524,530,531,577,608,652,759,818,839,844,862,866,875,932,943,992,998

Table I6. Studies reporting outcome measures on the physiological and neuropsychological effects of meditation practices (continued)

Domain	Category	Subcategory	N	Studies reporting outcome measure
Physio-logical	Sensory system (3)	Auditory test	3	300,946,981
	Thermoregulatory system (10)	Body temperature	10	134,199,313,392,503,531,608,696,838,844
	Urinary/excretory system (9)	Renal function	7	207,226,227,273,278,319,407,1012
		Salivary test	2	198,654
Cognitive/neuropsychological	Cognitive/neuropsychological (93)	Attention	19	754a 754b 78,182,208,280,294,387,577,602,666,678,751,793,838,841,848,930,974
		Creativity	4	293,500,615,915
		Intelligence	4	78,309,793,863
		Language	7	754a 78,177,178,181,279,793
		Memory	12	280,294,494b 78,310,431,793,815,863,867,930,940
		Other cognitive functions	11	273,279,280,310,618,665,681,863,930,974,999
		Perception	12	417,494,860b 78,208,418,518,554,616,654,915,974
		Reasoning	10	78,178,279,427,518,567,681,782,915,930
		Sensory motor functions	10	106,263,280,300,309,318,539,812,848,878
		Spatial ability	4	78,177,178,181

Appendix J. Characteristics of Studies on the Physiological and Neuropsychological Effects of Meditation Practices

Table J1. Characteristics of randomized controlled trials on the physiological and neuropsychological effects of meditation practices

Study, country	Condition Outcome examined System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Intervention: N participants	Comparison groups: Control	Comparison groups: N participants	Outcome category (measure)	Authors' conclusions
Agrawal RP, 2003[278] India	Type 2 DM Physiological Cardiovascular, digestive, endocrine, urinary/excretory	3 mo No	51.6 yr F = 46 M = 108	R: 200 C: 154 W: 46	Single Yoga	R: 100 C: 72 W: 28	Exercise	R: 100 C: 82 W: 18	CVF (BP), DIG (LDL, HDL, VLDL, TC, TG), END (CM [FBS, Hb-A1c]), UE (RFT [urea, Cr, microalbuminuria])	Yoga can be used as adjunct treatment in diabetes to improve glycemic control and quality of life

5-HIAA = 5-hyroxyindol acetic acid; ACF = adrenocortical functioning; ATN = attention; BDT = bone density test; BF = biofeedback; BP = blood pressure; BGM = blood gas measurement; C = number completed; Ca = calcium; cAMP = cyclic adenosine monophosphate; CF = cognitive function; CHD = chronic heart disease; cIMT = carotid intima-media thickness; CM = carbohydrate; metabolism; CNS-H = central nervous system hormone; COG/N = cognitive/neuropsychological; Cr = creatinine; CVF = cardiovascular functioning; d = day(s); DIG = digestive; DHEAS = dehydroepiandrosterone; DPV = digital pulse volume; ECG = electrocardiography; EMG = electromyography; END = endocrine; EPI = epinephrine; FBS = fasting blood sugar; GH = growth hormone; GSR = galvanic skin response; Hb = hemoglobin; Hb- A1c = hemoglobin A1c; HDL = high density lipoprotein; HE = health education; HR = heart rate; K = potassium; LDL = low density lipoprotein; LIP = lipoproteins; Lt = left; MEM = memory; Mg = magnesium; mo = month(s); MSK = musculoskeletal; Na = sodium; NE = norepinephrine; NER = nervous; NIDDM = non-insulin-dependent diabetes mellitus; NR = not reported; NT = no treatment; OGTT = oral glucose tolerance test; PAA = peak aortic acceleration; PFT = pulmonary function test; PMR = progressive muscle relaxation; R = number randomized (for RCTs); RES = respiratory; RFT = renal function test; RR = Relaxation Response; RSG = reasoning; Rt = right; SA = spatial ability; SBP = systolic blood pressure; SCL = skin conductance level; se = session(s); TC = total cholesterol; TG = triglyceride; TM® = Transcendental Meditation®; TSH = thyroid stimulating hormone; UE = urinary excretory; UFNB = unilateral forced nostril breathing; VA = verbal ability; VLDL = very low density lipoprotein; VO_2 = oxygen consumption; VO_2 max = maximum oxygen consumption; W = number withdrawals/losses to followup; wk = week(s); WL = waiting list; yr = year(s); Zn = zinc

Table J1. Characteristics of randomized controlled trials on the physiological and neuropsychological effects of meditation practice (continued)

Study, country	Condition / Outcome examined / System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range) / Gender	Characteristics of study population: N participants	Intervention: Intervention type / Meditation practice	Intervention: N participants	Comparison groups: Control	Comparison groups: N participants	Outcome category (measure)	Authors' conclusions
Alexander CN, 1991[279] United States	Elderly Physiological, neuro-psychological Cardiovascular, cognitive/neuro-psychological	18 mo No	80.7 yr F = 60 M = 13	R: 73 C: 73 W: 0	Single TM®	R: 21 C: 20 W: 1	MM	R: 23 C: 21 W: 2	CVF (BP), COG/N (CF, RSG, VA)	TM® group significantly improved cognitive flexibility, word fluency, and lowered SBP TM® group were more relaxed when finished
							Rest	R: 22 C: 21 W: 1		
							NT	R: 7 C: 11 W: NA		
Bahrke MS, 1978[304] United States	Healthy volunteers Physiological Cardiovascular	1 se NR	51.9 yr F = 0 M = 75	R: 75 C: 75 W: 0	Single RR	R: 25 C: 25 W: 0	Exercise	R: 25 C: 25 W: 0	CVF (HR, BGM [VO_2])	Acute physical activitynon-cultic meditationand a quiet rest session are equally effective in reducing state anxiety
							Rest	R: 25 C: 25 W: 0		

Table J1. Characteristics of randomized controlled trials on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Intervention: N participants	Comparison groups: Control	Comparison groups: N participants	Outcome category (measure)	Authors' conclusions
Block RA, 1989[177] United States	College/university students Neuropsychological Cognitive/neuro-psychological	1 se NR	Age NR F = 30 M = 30	R: 60 C: 60 W: 0	Single UFNB (Lt)	R: 20 C: 20 W: 0	Yoga	R: 20 C: 20 W: 0	COG/N (SA, VA)	Men performed better than women on spatial tasks but women had better results on verbal task Sex differences should be considered in cerebral processes and cognitive performance
							Rest	R: 20 C: 20 W: 0		
Blumenthal JA, 1991[280] United States	Elderly Physiological, neuro-psychological Cardiovascular, cognitive/neuro-psychological, digestive, musculoskeletal	14 mo Yes	67 yr F = 51 M = 50	R: 101 C: 97 W: 4	Single Yoga	R: 33 C: 31 W: 2	Exercise	R: 34 C: 34 W: 0	CVF (HR, BGM [VO_2, VO_2 max], ECG), COG/N (MEM, ATN, CF), DIG (LDL, HDL, TC, TG), MSK (BDT)	Subjects experienced 10%-15% improvement in aerobic capacity after 4 mo of aerobic exercise Few improvements in cognitive performance
							WL	R: 34 C: 32 W: 2		

Table J1. Characteristics of randomized controlled trials on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Intervention: N participants	Comparison groups: Control	Comparison groups: N participants	Outcome category (measure)	Authors' conclusions
Bose S, 1987[305] India	College/university students Physiological Cardiovascular	3 mo NR	17-23 yr F = 0 M = 200	R: 200 C: 200 W: 0	Single Shava-sana	R: 30 C: 30 W: 0	NT NT	R: 29 C: 29 W: 0 R: 141 C: 141 W: 0	CVF (BP)	No significant differences in uric acidcholesterol or fibrinolysis time in the two groups; Significant reduction in response to cold pressor tests after Shavansana training
Bowman AJ, 1997[281] United Kingdom	Elderly Physiological Cardiovascular	1.5 mo No	67 yr F = 17 M = 23	R: 40 C: 26 W: 14	Single Yoga	R: 20 C: 14 W: 6	Exercise	R: 20 C: 12 W: 8	CVF (BP, HR, BGM [VO_2 max], HR variability, baroreflex sensitivity, Max aortic velocity, PAA, cAMP)	Six wk of aerobic exercise training did not modify baroreflex sensitivity among healthy, elderly, sedentary, normotensive subjects

Table J1. Characteristics of randomized controlled trials on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range)	Gender	N participants	Intervention: Intervention type Meditation practice	N participants	Comparison groups: Control	N participants	Outcome category (measure)	Authors' conclusions
Broota A, 1995[204] India	Hypertension Physiological Cardiovascular, nervous	8 se NR	NR	F = 0 M = 40	R: 40 C: 40 W: 0	Single Shava-sana	R: 10 C: 10 W: 0	PMR	R: 10 C: 10 W: 0	CVF (BP), NER (GSR)	Three Yoga techniques were effective in reducing symptoms of hypertension Shavasana was most effective, followed by Broota, and Jacobson's technique
								Rest	R: 10 C: 10 W: 0		
								NT	R: 10 C: 10 W: 0		
Fields JZ, 2002[282] United States	Elderly Physiological Cardiovascular, digestive, endocrine	12 mo Yes	74.2 yr	F = 16 M = 27	R: 57 C: 43 W: 14	Compo-site TM® + herbal food + diet + Yoga asan-as	R: 14 C: 8 W: 6	Exercise	R: 9 C: 5 W: 4	CVF (BP, cIMT), DIG (LIP, LDL, HDL, TG), END (CM [FBS, OGTT, glyco-Hb, fasting insuline])	The multimodality traditional approach can attenuate atherosclerosis in older subjectsparticularly those with marked CHD risk
								NT	R: 20 C: 16 W: 4		
Hoffman JW, 1982[283] United Kingdom	Healthy volunteers Physiological Cardiovascular, endocrine	1 mo No	25.4 yr	F = 8 M = 11	R: 30 C: 19 W: 11	Single RR	R: 15 C: 10 W: 5	Rest	R: 15 C: 9 W: 6	CVF (BP, HR), END (ACF [NE])	With RR, more NE is required to produce the normal compensatory increase in HR and BP RR may reduce adrenergic end-organ responsivity

Table J1. Characteristics of randomized controlled trials on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Intervention: N participants	Comparison groups: Control	Comparison groups: N participants	Outcome category (measure)	Authors' conclusions
Jin P, 1992[307] Australia	Healthy volunteers Physiological Cardiovascular, endocrine	2 d NR	36.2 yr F = 48 M = 48	R: 96 C: 96 W: 0	Single Tai Chi	R: 24 C: 24 W: 0	Exercise	R: 24 C: 24 W: 0	CVF (BP, HR), END (ACF [cortisol, salivary EPI, NE, and dopamine])	Tai Chi reduced state anxiety and enhanceed vigour This effect could be partially due to subjects' high expectations about gains from Tai Chi
							HE	R: 24 C: 24 W: 0		
							Reading	R: 24 C: 24 W: 0		

Table J1. Characteristics of randomized controlled trials on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Intervention: N participants	Comparison groups: Control	Comparison groups: N participants	Outcome category (measure)	Authors' conclusions
Monro R, 1992[308] United Kingdom	Type 2 DM Physiological Endocrine	12 wk NR	54.9 yr F = 11 M = 11	R: 21 C: 21 W: 0	Single Yoga	R: 11 C: 11 W: 0	Medica-tion	R: 10 C: 10 W: 0	END (CM [FBS, Hb-A1c])	Yoga classes improved glucose homeostasis in diabetic patients (NIDDM)
Peters RK, 1977[284] United States	Healthy volunteers Physiological Cardiovascular	12 wk Yes	33.4 yr F = 96 M = 82	R: 190 C: 178 W: 12	Single RR	R: 58 C: 54 W: 4	Rest	R: 39 C: 36 W: 3	CVF (BP)	RR significantly reduced BPeven if the initial BP was within normal ranges
							NT	R: 39 C: 36 W: 3		
							NT	R: 54 C: 52 W: 2		
Pollak MH, 1979[288] United States	Healthy volunteers Physiological Cardiovascular, nervous, respiratory	1 se No	NR F = 15 M = 15	R: 41 C: 30 W: 11	Single RR	R: 0 C: 10 W: 0	PMR	R: NR C: 10 W: NR	CVF (HR, DPV), NER (SCL), RES (respiratory rate)	RR can produce a significant changes in HR
							Rest	R: NR C: 10 W: NR		

Table J1. Characteristics of randomized controlled trials on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Intervention: N participants	Comparison groups: Control	Comparison groups: N participants	Outcome category (measure)	Authors' conclusions
Reddy KM, 1990[309] United States	Athletes Physiologicalneuro-psychological Blood, cardiovascular, cognitive/neuro-psychological, respiratory	6 wk NR	19.8 yr F = 7 M = 23	R: 30 C: 30 W: 0	Single TM®	R: 15 C: 15 W: 0	WL	R: 15 C: 15 W: 0	BC (Hb), CVF (HR, BP), COG/N (CF), RES (PFT [VT])	TM® improved both short- and long-term athletic performance and physiological development TM® increased physiological efficiency and flexibility
Sun WY, 1996[285] United States	Elderly Physiological Cardiovascular	12 wk Yes	>60 yr F = 13 M = 7	R: 20 C: 20 W: 0	Single Tai Chi	R: 10 C: 10 W: 0	NT	R: 10 C: 10 W: 0	CVF (BP, HR)	Tai Chi produced significant improvements in resting BP, stress level, and shoulder and knee flexibility
Telles S, 1994[140] India	Healthy volunteers Physiological Cardiovascular, nervous, respiratory	1 mo NR	34 yr F = 0 M = 48	R: 48 C: 48 W: 0	Single UFNB (Rt)	R: 12 C: 12 W: 0	Yoga	R: 12 C: 12 W: 0	CVF (HR, BGM [VO_2]), NER (GSR), RES (respiratory rate)	UFNB have a marked activating or relaxing effect on the sympathetic nervous system
							Yoga	R: 24 C: 24 W: 0		

Table J1. Characteristics of randomized controlled trials on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Intervention: N participants	Comparison groups: Control	Comparison groups: N participants	Outcome category (measure)	Authors' conclusions
Thornton EW, 2004[286] Hong Kong	Healthy volunteers Physiological Cardiovascular	3 mo No	47.8 yr F = 40 M = 0	R: 40 C: 34 W: 6	Single Tai Chi	R: 20 C: 17 W: 3	NT	R: 20 C: 17 W: 3	CVF (BP)	A 12-wk Tai Chi program improved the dynamic balance of middle-aged adults
Young DR, 1999[287] United States	Elderly Physiological Cardiovascular	12 wk No	66.7 yr F = 49 M = 13	R: 62 C: 62 W: 0	Single Tai Chi	R: 31 C: 31 W: 0	Exercise	R: 31 C: 31 W: 0	CVF (BP, BGM [VO_2 max])	Tai Chi and moderate intensity aerobic exercise may have similar effects on BP in previously sedentary older individuals
Zaichkowsky LD, 1978[191] United States	College/university students Physiological Musculoskeletal	12 wk NR	NR F = 0 M = 0	R: 48 C: 48 W: 0	Single RR	R: 14 C: 14 W: 0	TM®	R: 7 C: 7 W: 0	MSK (EMG frontalis)	RR, TM®, and BF resulted in significant decreases in frontalis muscle tension
							BF	R: 14 C: 14 W: 0		
							PMR	R: 13 C: 13 W: 0		

Table J2. Characteristics of nonrandomized controlled trials on the physiological and neuropsychological effects of meditation practices

Study, country	Condition Outcome examined System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range), Gender	Characteristics of study population: N participants	Intervention: Intervention type, Meditation practice	Intervention: N participants	Comparison groups: Control	Comparison groups: N participants	Outcome category (measure)	Authors' conclusions
Abrams AI, 1978[289] United States	Prison inmates Physiological Cardiovascular	14 wk No	Age NR F = 0 M = 89	E: 115 C: 89 W: 26	Single TM®	E: 60 C: 49 W: 11	WL	E: 55 C: 40 W: 15	CVF (BP, HR)	TM® reduced anxiety, neuroticism, hostility, and insomnia
Chen WW, 1997[290] United States	Elderly Physiological Cardiovascular, musculoskeletal	16 wk No	50-74 yr F = NR M = NR	E: 36 C: 28 W: 8	Single Tai Chi	E: 23 C: 18 W: 5	NT	E: 13 C: 10 W: 3	CVF (BP, HR), MSK (EMG)	Tai Chi can benefit health promotion and disease prevention for older adults
Cooper MJ, 1990[291] Israel	Healthy volunteers Physiological Cardiovascular, digestive	10 mo No	43 yr F = 19 M = 25	E: 55 C: 44 W: 11	Single TM®	E: 34 C: 23 W: 11	NT	E: 21 C: 21 W: 0	CVF (BP), DIG (TC)	TM® may have value as an adjunct treatment in reducing BP and cholesterol levels

BF = biofeedback; BP = blood pressure; C = number completed; COG/N = cognitive/neuropsychological; CTY = creativity; CVF = cardiovascular functioning; DIG = digestive; E = number enrolled; EMG = electromyography; HR = heart rate; Lt = left; MSK = musculoskeletal; mo = month(s); NER = nervous; NR = not reported; NT = no treatment; PR = pulse rate; RES = respiratory; Res-v = respiratory variability; RR = Relaxation Response; SA = spatial ability; SRL = skin resistance level; TC = total cholesterol; TM® = Transcendental Meditation®; UFNB = unilateral forced nostril breathing; VA = verbal ability; W = number withdrawals/losses to followup; wk = week(s); yr = year(s)

Table J2. Characteristics of nonrandomized controlled trials on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Intervention: N participants	Comparison groups: Control	Comparison groups: N participants	Outcome category (measure)	Authors' conclusions
Cuthbert B, 1981[306b] United States	College/university students Physiological Cardiovascular, musculoskeletal, nervous, respiratory	3 se NR	Age NR F= 0 M=60	E: 60 C: 60 W: 0	Single RR	E: 20 C: 20 W: 0	BF	E: 20 C: 20 W: 0	CVF (HR), MSK (EMG), NER (SRL), RES (Res-v)	Meditation leads to greater instructed heart rate slowing than does training that includes high-density biofeedback
							Rest	E: 20 C: 20 W: 20		
De Armond DL, 1996[292] United States	Workers (Technology) Physiological Cardiovascular, digestive	3 mo NR	43 yr F= 17 M=58	E: 76 C: 75 W: 1	Single TM®	E: 38 C: 38 W: 0	NT	E: 38 C: 37 W: 1	CVF (BP), DIG (TC)	TM® has effects in psychology, behavior and physiology and is an effective stress-reduction intervention
Mohan SM, 2002[180] Malaysia	Healthy volunteers Physiological, cardiovascular	1 se No	19-24 yr F= NR M=NR	E: 58 C: NR W: NR	Single UFNB (Lt)	E: NR C: NR W: NR	Yoga	E: NR C: NR W: NR	CVF (PR)	UFNB may affect sympathetic tone

Table J2. Characteristics of nonrandomized controlled trials on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup, ITT	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Intervention: N participants	Comparison groups: Control	Comparison groups: N participants	Outcome category (measure)	Authors' conclusions
Sanders B, 1994[181] United States	College/university students Neuropsychological Cognitive/neuropsychological	NR NR	NR F = 48 M = 48	E: 96 C: 96 W: 0	Single UFNB (Lt)	E: 32 C: 32 W: 0	Yoga	E: 32 C: 32 W: 0	COG/N (SA, VA)	UFNB did not significantly alter nostril dominance
							Rest	E: 32 C: 32 W: 0		
Travis FT, 1990[293] United States	College/university students Neuropsychological Cognitive/ Neuropsychological	5 mo No	NR F = 37 M = 34	E: 96 C: 71 W: 25	Single TM®	E: 46 C: 35 W: 11	NT	E: 40 C: 36 W: 4	COG/N (CTY)	Practicing TM® for 5 mo had a significant effect on primary process creativity

Table J3. Characteristics of before-and-after studies on the physiological and neuropsychological effects of meditation practices

Study, country	Condition Outcome examined System evaluated	Duration/followup	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Comparison groups	Outcome category (measure)
Agarwal BL, 1990[295] India	Hypertension Physiological Cardiovascular	6 mo	49.9 yr F= 4 M=12	E: 24 C: 16 W: 8	Single TM®	CVF (BP)	TM® may serve as initial treatment for moderate hypertension.
Anantharaman RN, 1984[310] India	Healthy volunteers Physiological, neuropsychological Cardiovascular, cognitive/neuro-psychological, respiratory	3 mo	34.2 yr F= 20 M=0	E: 20 C: 17 W: 3	Composite Yoga (asanas + pranayama)	CVF (BP, HR), COG/N (CF, MEM), RES (BR)	Yoga practice significantly decreased physiological variables and improved some psychological variables

ACF = adrenocortical functioning; AEI = artery elasticity index; ATN = attention; BC = blood composition; BGM = blood gas measurement; BHT = breath holding time; BL = blood lactate; BM = blood measurement; BP = blood pressure; BR = breathing rate; BS = blood sugar; C = number completed; CF = cognitive function; ChE = cholinesterase; CM = carbohydrate; metabolism; COG/N = cognitive/neuropsychological; CV = cardiovascular; CVF = cardiovascular functioning; d = day(s); DIG = digestive; DM = diabetes mellitus; E = number enrolled; ECG = electrocardiography; END = endocrine; FBS = fasting blood sugar; FEV_1 = forced expiratory volume in first second; FFA = free fatty acid; FPA = finger plethysmogram amplitude; FVC = forced vital capacity; Glc = glucose; GLH = glycosylated hemoglobin; GSR = galvanic skin response; HDL = high density lipoprotein; HI = humoral immunity; HR = heart rate; IMS = immune system; LDH = lactate dehydrogenase; LDL = low density lipoprotein; LIP = lipoproteins; Lt = left; MEM = memory; MEP = maximum expiratory pressure; MIP = maximum inspiratory pressure; mo = month(s); MVV = maximal voluntary ventilation; NIDDM = non-insulin-dependent diabetes mellitus; NER = nervous; N/M = nutrition/metabolism; NR = not reported; OCL = ocular; OGTT = oral glucose tolerance test; PEF (25-75) = peak expiratory flow at middle portion of expiration; PEFR = peak expiratory flow rate; PER = perception; PFT = pulmonary function test; PIFR = peak inspiratory flow rate; PO_2 = pressure of oxygen; PP = pulse pressure; PPT = physical performance test; RA = renin activity; RER = respiratory exchange ratio; RES = respiratory; RT = reaction time; Rt = right; SaO2 = saturated oxygen; SBPse = session(s); SEN = sensory; SI = serum insulin; SMF = sensory motor function; SVR = systemic vascular resistance; TC = total cholesterol; TG = triglyceride; THR = thermo-regulatory; TM® = Transcendental Meditation®; TP = total protein; TV = tidal volume; UE = urinary excretory; UFNB = unilateral forced nostril breathing; UL = urine lactate; VCO_2 = carbon dioxide production; Ve = minute ventilation; VLDL = very low density lipoprotein; VO_2 = oxygen consumption; VO_2 max = maximum oxygen consumption; yr = year(s); W = number withdrawals/losses to followup; wk = week(s)

Table J3. Characteristics of before-and-after studies on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup	Characteristics of study population: Age (mean/range) Gender	N participants	Intervention: Intervention type Meditation practice	Outcome category (measure)	Authors' conclusions
Benson H, 1974[311] United States	Hypertension Physiological Cardiovascular	NR	Age NR F= NR M=NR	E: 22 C: 22 W: 0	Single TM®	CVF (BP)	TM® reduced elevated systemic arterial BP
Bhargava R, 1988[312] India	Healthy volunteers Physiological Cardiovascular, nervous, respiratory	4 wk	19-28 yr F = 0 M = 10	E: 10 C: 10 W: 0	Single Pranayama	CVF (BP, HR), NER (GSR), RES (BHT)	Pranayama breathing exercises altered autonomic responses to BH by increasing vagal tone and decreasing sympathetic discharges
Chen JC, 2004[297] Australia	College/university students Physiological Cardiovascular, ocular	1 se	21.8 yr F = NR M = NR	E: 17 C: 17 W: 0	Single UFNB	CVF (BP, HR), OCL (ophthalmologic test)	UFNB produced changes in intraocular pressure and had a greater effect on accomodation for those with high initial tonic activity

Table J3. Characteristics of before-and-after studies on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Outcome category (measure)	Authors' conclusions
Damodaran A, 2002[294] India	Hypertension Physiological, neuro-psychological Cardiovascular, cognitive/neuropsy-chological, nervous, respiratory	3 mo	45.8 yr F = 4 M = 16	E: 20 C: 20 W: 0	Composite Yoga (asanas + pranayama)	CVF (BP, HR), COG/N (ATN, MEM, PER, SMF), NER (steadiness, coordination, choice RT, GSR, grip) RES (BR)	Yoga can play an important role in risk modification for CV diseases in mild to moderate hypertension
Jain SC, 1993[298] India	Type II DM Physiological Endocrine	40 d	45.9 yr F = 30 M =119	E: 149 C: 149 W: 0	Single Yoga	CM (FBS, OGTT)	Yoga may be considered as a beneficial adjuvant method for diabetic (NIDDM) patients
Jones AY, 2005[296] Canada	Healthy volunteers Physiological Cardiovascular, respiratory	12 wk	52.6 yr F = 50 M = 10	E: 60 C: 51 W: 9	Single Tai Chi	CVF (BGM [SaO_2, VCO_2], BP, HR), RES (PFT [FEV_1, FVC, PIFR, PEFR, PEF 25-50])	A community-based Tai Chi program produced beneficial effects comparable to those reported from experimental laboratory trials of Tai Chi

Table J3. Characteristics of before-and-after studies on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Outcome category (measure)	Authors' conclusions
Jones BM, 2001[299] Hong Kong	Healthy volunteers Physiological Cardiovascular, endocrine, immune	14 wk	43.9 yr F = 11 M = 8	E: 19 C: 10 W: 9	Single Qi Gong	CVF (BP, HR), END (ACF [cortisol], IMS (HI [cytokines])	Cortisol may be lowered by short-term practice of Qigong Concomitant changes in numbers of cytokine-secreting cells were observed
Joseph S, 1981[313] India	Army/militar Physiological Blood, cardiovascular, digestive, endocrine, nervous, nutrition/metabolism, respiratory, thermoregulatory	3 mo	24.9 yr F = 0 M = 10	E: 10 C: 10 W: 0	Composite Yoga (prayer + asanas + pranayama + meditation)	BM (ChE, LDH), CVF (BP, HR, BGM [VO_2]), DIG (TC, FFA, LIP) NER (CNS-H [dopamine-B hydroxylase]), END (CM [FBS]), N/M (MP [MAO], TP), RES (BR), THR (skin temperature)	A 3-mo Yoga program resulted in a gradual shift of the autonomic balance towards a relative parasympathetic dominance
Joshi LN, 1992[314] India	College/university students Physiological Respiratory	6 wk	18.5 yr F = 42 M = 33	E: 75 C: 75 W: 0	Single Pranayama	RES (PFT [FEV_1, FVC, BHt, MVV, PEFR, BR])	Regular pranayama breathing improved pulmonary functions (FVC, MVV, PEFR), increased tolerance to CO_2, and decreased BR

Table J3. Characteristics of before-and-after studies on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition Outcome examined System evaluated	Duration/followup	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Outcome category (measure)	Authors' conclusions
Kocer I, 2002[315] Turkey	College/university students Physiological Ocular	3 se	20.6 yr F = 26 M = 24	E: 50 C: 50 W: 0	Single UFNB	OCL (Intraocular pressure [Rt eye/Rt nostril, Rt eye/Lt nostril, Lt eye/Rt nostril, Lt eye/Lt nostril])	UFNB decreased intraocular pressure especially in menperhaps due to increasing sympathetic nervous system activity
Lim YA, 1993[316] United States	College/university students Physiological Cardiovascular, respiratory	1 se	20.5 yr F = 5 M = 5	E: 10 C: 10 W: 0	Single Qi Gong	CVF (HR, BGM [V_{O_2}, V_{CO_2}]), RES (PFT [TV, Ve, RER, BR])	Qigong can can improve ventilatory efficiency of O_2 uptake and CO_2 production by 20%
Liu S, 1996[317] United States	College/university students Physiological Cardiovascular, digestive, endocrine	8 wk	22.1 yr F = 8 M = 6	E: 14 C: 14 W: 0	Single Tai Chi	CVF (BP, HR, PPT), DIG (TC), CM (BS)	An 8-wk Tai Chi program can improve CV fitness, balance, flexibility, and stress control No effect on blood cholesterol and glucose levels was found
Madanmohan, 1992[300] India	College/university students Physiological Cognitive/neuropsy-chological, respiratory, sensory	12 wk	18-21 yr F = 0 M = 27	E: 27 C: 27 W: 0	Single Yoga	COG/N (ATN), RES (MEP, MIP, BHT), SEN (auditory test)	A 12-wk yoga program resulted in a significant reduction in visual and auditory RT Yoga increasd respiratory pressures, BHT, and hand grip strength

Table J3. Characteristics of before-and-after studies on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition / Outcome examined / System evaluated	Duration/followup	Characteristics of study population: Age (mean/range) / Gender	Characteristics of study population: N participants	Intervention: Intervention type / Meditation practice	Outcome category (measure)	Authors' conclusions
Malathi A, 1989[318] India	Healthy volunteers Neuropsychological Cognitive/neuropsychological	6 wk	30-45 yr F = 83 M = 0	E: 83 C: 83 W: 0	Composite Yoga (asanas + pranayama)	COG/N (SMF)	Either 1 hr or 6 wk of Yoga asanas significantly reduced visual and auditory reaction times
Manjunatha S, 2005[301] India	Healthy volunteers Physiological Endocrine	4 wk	23.8 yr F = 3 M = 17	E: 20 C: 20 W: 0	Single Yoga (asanas)	END (CM [SI, OGTT, FBS, insulin sensitivity, post-prandial glucose test])	Asanas can lead to increased sensitivity of pancreatic B cells to glucose signals
Pollack AA, 1977[319] United States	Hypertension Physiological Cardiovascular, urinary/excretory	6 mo	40.5 yr F = 10 M = 10	E: 20 C: 20 W: 0	Single TM®	CVF (BP, HR), UE (RA)	It is unlikely that TM® contributes directly towards the lowering of BP The patients may experience a general feeling of well-being
Raju PS, 1986[320] India	Healthy volunteers Physiological Cardiovascular, nutrition/metabolism, respiratory	3 mo	23.7 yr F = 6 M = 6	E: 12 C: 12 W: 0	Composite Yoga (asanas + pranayama)	CVF (HR, BGM [PO_2, SaO_2, VO_2 max]), N/M (BL, UL, blood pyruvate), RES (Ve)	After 90 d of Yoga, BL increased during phase I Significant reduction of Ve and VO_2 in males in phase I and II Females tolerate higher loads of exercise in phases I and II

Table J3. Characteristics of before-and-after studies on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition / Outcome examined / System evaluated	Duration/followup	Characteristics of study population: Age (mean/range) Gender	Characteristics of study population: N participants	Intervention: Intervention type Meditation practice	Outcome category (measure)	Authors' conclusions
Schmidt TFH, 1994[302] Sweden	Healthy volunteers Physiological Blood, cardiovascular, digestive	3 mo	29.7 yr F = 48 M = 58	E: 150 C: 106 W: 44	Composite Yoga + meditation + vegetarian diet	BC (fibrinogen), CVF (BP, HR), DIG (LDL,VLDL, HDL, TG)	Yoga and meditation along with low-fat, low-salt vegetarian diet, smoking cessation resulted in a substantial reduction of cardiovascular risk in healthy volunteers
Singh S, 2004[321] India	Type II DM Physiological Cardiovascular, endocrine, respiratory	40 d	30-60 yr F = NR M = NR	E: 24 C: 24 W: 0	Composite Yoga (asanas + pranayama)	CVF (BP, HR, ECG), BGM [CM (FBS, OGTT, GLH]), RES (PFT [FEV_1, FVC, PEFR, MVV])	Yoga asanas and pranayama produced better glycemic control and stable autonomic functions in type II DM
Sung BH, 2002[322] United States	Healthy volunteers Physiological Cardiovascular	1 se	35 yr F = NR M = NR	E: 25 C: 25 W: 0	Single Yoga breathing	CVF (HR, BP, stroke volume, SVR, AEI [large/small])	Yoga breathing has a favorable effect on small artery compliance resulting in lower BP
Telles S, 1993[323] India	Healthy volunteers Physiological Cardiovascular, nervous, respiratory	3 mo	34.7 yr F = 0 M = 40	E: 40 C: 40 W: 0	Composite Yoga (asanas + pranayama + mantra meditation + lectures)	CVF (BP, HR), NER (GSR), RES (PFT [BR, FEV1, FVC, PEFR, BHT])	3 mo of Yoga produced significant improvement in general health (weight, BP reduction, and improved lung function)

Table J3. Characteristics of before-and-after studies on the physiological and neuropsychological effects of meditation practices (continued)

Study, country	Condition / Outcome examined / System evaluated	Duration/followup	Characteristics of study population: Age (mean/range) / Gender	Characteristics of study population: N participants	Intervention: Intervention type / Meditation practice	Outcome category (measure)	Authors' conclusions
Telles S, 1993[83] India	Healthy volunteers Physiological Cardiovascular, nervous, respiratory	6 se	34.1 yr F = 0 M = 18	E: 18 C: 18 W: 0	Single Yoga (Brahma-kumaris Raja)	CVF (HR, FPA), NER (GSR), RES (BR)	There is no single model of sympathetic activation to describe the physiological effects of a meditation technique
Vijayalakshmi P, 2004[303] India	Hypertension Physiological Cardiovascular	4 wk	50 yr F = 0 M = 13	E: 13 C: 13 W: 0	Composite Yoga (asanas + pranayama)	CVF (BP, HR, PP)	Yoga optimizes the sympathetic response to stressful stimuli (handgrip) Yoga restores the autonomic regulatory reflex in hypertensive patients