

Mindfulness-Based Stress Reduction as a Stress Management Intervention for Healthy Individuals: A Systematic Review

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Manoj Sharma, MBBS, MCHES, PhD, FAAHB¹,
and Sarah E. Rush, MA, CHES²

Abstract

Stress is a global public health problem with several negative health consequences, including anxiety, depression, cardiovascular disease, and suicide. Mindfulness-based stress reduction offers an effective way of reducing stress by combining mindfulness meditation and yoga in an 8-week training program. The purpose of this study was to look at studies from January 2009 to January 2014 and examine whether mindfulness-based stress reduction is a potentially viable method for managing stress. A systematic search from Medline, CINAHL, and Alt HealthWatch databases was conducted for all types of quantitative articles involving mindfulness-based stress reduction. A total of 17 articles met the inclusion criteria. Of the 17 studies, 16 demonstrated positive changes in psychological or physiological outcomes related to anxiety and/or stress. Despite the limitations of not all studies using randomized controlled design, having smaller sample sizes, and having different outcomes, mindfulness-based stress reduction appears to be a promising modality for stress management.

Keywords

mindfulness-based stress reduction, mind-body interventions, stress, anxiety

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Introduction

Stress is a pervasive issue in modern society and has become a global public health problem.^{1,2} Continuous stress may lead to unproductive rumination that consumes energy and reinforces the experience of stress itself.³ Additionally, exaggerated stress can challenge resilience aspects⁴⁻⁶ such as hope⁷ and capacity to forgive.⁸ Although certain levels of stress may result in improved functioning, there is evidence that a great deal of stress can negatively affect both physical and mental health.⁹⁻¹¹ Stress has been linked to autoimmune disease,¹² migraines,¹³ obesity,¹⁴ muscle tension and backache,¹⁵ high cholesterol,¹⁶ coronary heart disease,¹⁷ hypertension,¹⁸ stroke,¹⁹ and other quality of life issues that affect humans.

Previous attempts to manage and disrupt the negative effects of stress on the mind and body have included various methods such as time management, conflict resolution, communication skills, social support, humor, spirituality, meditation, exercise, yoga, and massage.²⁰ Literature has shown a positive relationship between time management skills and stress levels.²¹ Social support has helped patients adjust to their illnesses,²² helped African American women feel connected to their neighborhoods,²³ increased HIV/AIDS patients' adherence to their medication regimens²⁴ and helped alleviate their depressive symptoms,^{25,26} and eliminated rates of abandonment of

children with Down syndrome in Thailand.²⁷ Communication techniques, such as active listening, have been examined as an effective means of managing social stressors.^{28,29} Humor can diffuse stressful situations and preclude negative life events from resulting in mood instabilities.²⁰ Humor also helps in managing stress by increasing cheerfulness, which often leads to increased social support. Spirituality, meditation, and yoga have all shown decreases in chronic pain, anxiety, stress, and depression.³⁰⁻³⁴

One stress management technique that has gained increasing attention is the concept of mindfulness, which originally has its roots in Buddhism and can be found in the *Abhidhamma* and the *Visuddhimagga*, a summary of the portion that deals with meditation. Mindfulness is defined by Kabat-Zinn³⁵ as a moment-to-moment awareness and is cultivated by purposefully paying attention to the present moment, with a nonjudging,

¹ University of Cincinnati, Cincinnati, OH, USA

² University of Alabama, Tuscaloosa, AL, USA

Corresponding Author:

Manoj Sharma, MBBS, MCHES, PhD, FAAHB, Health Promotion & Education Program & Environmental Health, University of Cincinnati, 526 HA Teachers College, PO Box 210068, Cincinnati, OH 45221, USA.

Email: manoj.sharma@uc.edu

nonstriving attitude of acceptance.^{36,37} This mental state allows one to experience thoughts and feelings in a way that emphasizes their subjectivity and transient nature.³⁸ Mindfulness has been associated with increased health outcomes. For example, Kabat-Zinn reported improvements in pain, body image, activity levels, medical symptoms, mood, affect, somatization, anxiety, depression, and self-esteem.³⁹ Other studies have demonstrated benefits in helping people cope with many problems, including chronic pain,⁴⁰ fatigue,⁴¹ stress reduction,^{42,43} various forms of cancer,⁴⁴ heart disease,⁴⁵ type 2 diabetes,⁴⁶ psoriasis,⁴⁷ and insomnia.⁴⁸

Mindfulness-based stress reduction³⁶ is a widely disseminated and frequently cited example of mindfulness training that has been shown to reduce stress, depression, and anxiety.^{49,50} Mindfulness-based stress reduction programs have been widely researched and positive results reported among an array of clinical and nonclinical populations, including cancer patients,⁵¹⁻⁵³ mixed illness populations,^{49,54,55} health care professionals,⁵⁶ continuing education students,⁴³ and college undergraduates.⁵⁷ Mindfulness-based stress reduction teaches individuals to observe situations and thoughts in a nonjudgmental manner without reacting to them thoughtlessly and helps people develop a more automatic consciousness of experiences, and could represent an effective instrument for the reduction of stress.^{58,59} This research gives some indication of how mindfulness-based stress reduction can help people cope with the impact on their lives, of various conditions and stressors.

Mindfulness-based stress reduction sessions provide training in formal mindfulness practices, including body scan, sitting meditation, and Hatha yoga. The body scan involves paying attention to parts of the body and bodily sensations in sequence, in a gradual sweeping of attention through the body from feet to head. In sitting meditation, the primary focus of this mindful attention is on breathing, the rising and falling abdomen, as well as on other perceptions and a state of nonjudgmental awareness of cognitions and the stream of thoughts and distractions that flow through the mind. Mindful movement is based on Hatha yoga and focuses on moving the body through a series of postures to develop greater strength, balance, flexibility, and body awareness. Hatha yoga is included in the program as a means of encouraging attentiveness to body sensations and movement. In all of these exercises, when thoughts arise and attention wanders, the practice is to return the attention to the intended focus. Participants are also encouraged to practice mindfulness informally by bringing attention to emotions, thoughts, and appraisals that occur while engaged in everyday activities, including walking, eating, driving, working, and conversing.⁶⁰ MBSR is based on training attention through straightforward, secular, meditation techniques. It seeks to change our relationship with stressful thoughts and events, by decreasing emotional reactivity and enhancing cognitive appraisal.⁶¹ From the Western psychological perspective, when individuals practice mindfulness in their own way, during both formal meditation and during engagement in everyday activities, an awakening process occurs.⁶²

The benefits of the standardized full-length mindfulness-based stress reduction curriculum are well documented, and the time commitment is significant. The full-length standard mindfulness-based stress reduction program is among the most widely researched mindfulness procedures. Mindfulness-based stress reduction is effective in fostering emotional well-being and reducing psychological distress among nonclinical healthy individuals and persons with chronic psychological disorders. Mindfulness-based stress reduction's standard curriculum is conducted in a structured 8-week group format, during which participants meet weekly for 2.5-hour group sessions in addition to one 6-hour daylong retreat, for a total of 26 contact hours. Unfortunately, most people do not have the time, resources, or accessibility needed to participate in extensive meditation programs.⁶³

A literature review was published in 2009 that looked at all the trials till that time which had studied the effects of mindfulness-based stress reduction on stress management in nonclinical populations.⁶⁴ The study summarized the results from 10 such trials and found positive effects of mindfulness-based stress reduction though there were methodological shortcomings and the numbers of studies were too small. Since 2009 several additional studies have been published in this area. Hence, the aim of this review was to examine these additional studies and assess whether mindfulness-based stress reduction can be an alternative and complementary approach for stress reduction in nonclinical populations.

Questions being addressed in this review include the following:

- Has mindfulness-based stress reduction been found to be efficacious in decreasing stress in otherwise healthy individuals since the 2008 review?
- Is there sufficient data available to draw conclusions regarding the efficacy of mindfulness-based stress reduction in stress management?
- What are the methodological limitations of present research studies and how can these be addressed in future research?
- What are the common outcome measures measured by studies and which ones are more important for future studies?

Methods

A systematic review of studies involving mindfulness-based stress reduction interventions among healthy individuals was the method used in this study. To be included in this study the article must meet the following criteria: (a) be published in the English language; (b) included in following databases: CINAHL (Cumulative Index to Nursing and Allied Health), Medline, or Alt HealthWatch; (c) study conducted between January 2009 and January 2014; (d) include any mindfulness-based stress reduction as an intervention; (e) use any quantitative study design for evaluation; (f) conducted in healthy adults (older than 18 years); (g) examine outcome measures related to stress and anxiety; and (h) include evaluation results as opposed to mere description of the protocol. Articles were excluded from this review due to the following criteria: (a) studies that did not evaluate

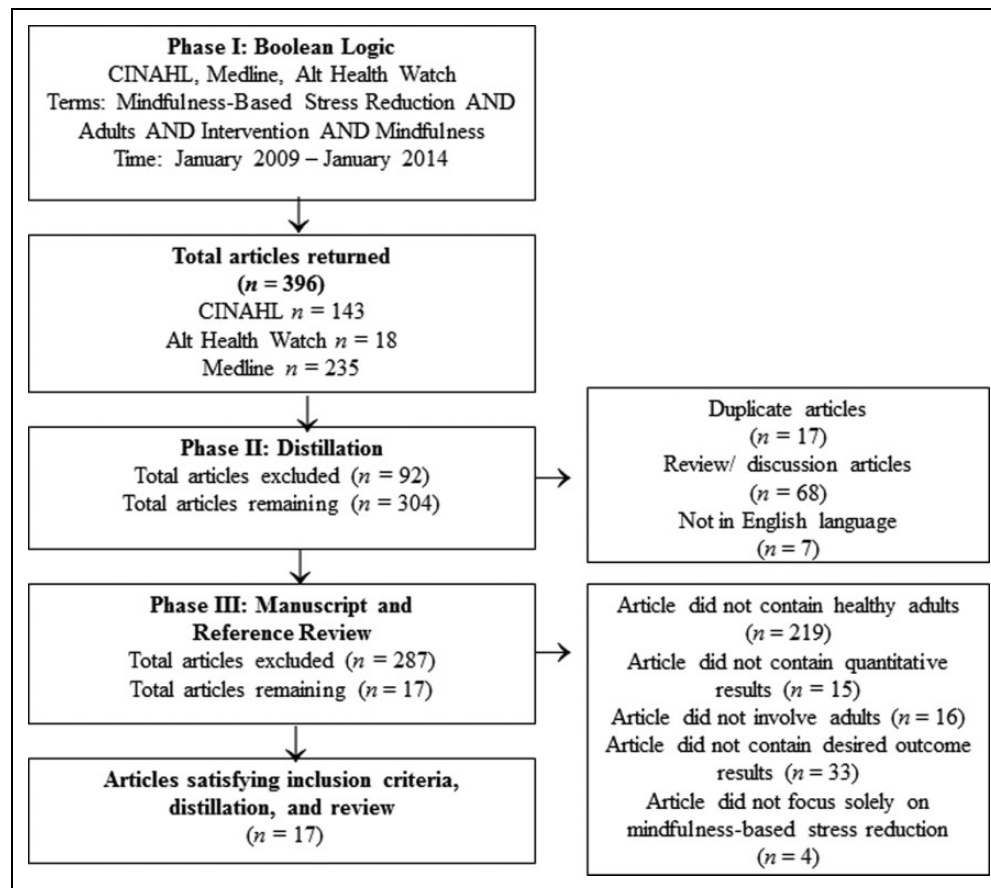


Figure 1. The 3-step data extraction process.

the intervention or implemented a quantitative design; (b) did not sample apparently healthy participants; (c) did not include selected outcome measures; (d) used other stress reduction strategies; and (e) did not index in any of the following databases: CINAHL (Cumulative Index to Nursing and Allied Health), Medline, or Alt HealthWatch.

Three phases of data review were conducted for this study (Figure 1). To identify studies meeting these criteria, Medline, Alt HealthWatch, and CINAHL database searches were performed for Phase I. Boolean terms used to identify studies meeting the criteria included “Mindfulness-Based Stress Reduction AND Adults AND Intervention AND Mindfulness” for the time period January 2008 to December 2013.

Using the aforementioned terms/phrases, 396 articles were returned from Medline ($n = 235$), Alt HealthWatch ($n = 18$), and CINAHL ($n = 143$). Phase II included preliminary distillation of the articles by eliminating duplicates ($n = 17$), review/discussion/other articles ($n = 68$), and studies not in the English language ($n = 7$). In Phase III, comprising manuscript review of the remaining articles ($n = 287$), articles were eliminated that did not contain desired outcome results ($n = 33$), did not involve adults ($n = 16$), did not involve healthy individuals ($n = 219$), did not have quantitative results ($n = 15$), or did not focus solely on mindfulness-based stress reduction ($n = 4$). Hence, the remaining articles ($n = 17$) satisfied the eligibility criteria.

Results

As a result of the data extraction process, 17 articles were found satisfying the eligibility criteria. Table 1 summarizes

the studies including the year of publication, authors/country where the study was performed, study design and sample size, age of participants, intervention modality, intervention dosage, outcome measures, and the salient findings. The studies are arranged by year of publication in the ascending order starting from 2009. Within a given year studies are arranged alphabetically by the last name of the first author.

Of the 17 interventions, the majority were done in the United States ($n = 9$),^{63,65,68-74,76} followed by the United Kingdom ($n = 2$).^{67,78} One each was implemented in Australia,⁷⁷ Canada,⁶⁶ Netherlands,⁷⁹ Norway,⁷⁵ and Spain.⁶⁰ Of the 17 interventions, 5 were randomized controlled designs,^{70,72,75,76,79} 2 studies used quasi-experimental designs,^{63,73} and 10 used pretest–posttest designs.^{60,65-69,71,74,77,78} The mean sample size calculated for all 17 studies in this review was 100.94, with a range of 11 to 288. Total sample sizes (n) were typically between 30 and 155, with 3 studies having sample sizes less than 30^{60,67} and 3 studies with sample sizes more than 155.^{69,75,78} The samples with which the mindfulness-based stress reduction interventions for stress management were conducted were in undergraduate students ($n = 2$),^{63,70} general public in community settings ($n = 5$),^{65,66,69,72,79} with health care students ($n = 2$),^{73,75} with health care professionals/employees ($n = 5$),^{60,68,71,74,77} with primary school teachers ($n = 2$),^{67,76} and 1 study was online.⁷⁸

Table 1. Summary of Mindfulness-Based Stress Reduction Interventions for Healthy Individuals, January 2009 to January 2014 (N = 17).

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
2009	Cordon, Brown, and Gibson ^{65/} United States	Pretest–posttest design (n = 131), sample consisted of 65 with secure attachments and 66 with insecure attachments	21 to 79 years, with mean of 49.57 years for secure group and 47.07 for insecure groups	Mindfulness-Based Stress Reduction	8 weekly 2.5-hour classes, daylong retreat during 6th week of program, 45 minutes a day/6 days a week practicing methods taught in class [27 hours of instruction + home practice]	Experiences in Close Relationships: Revised Questionnaire	<ul style="list-style-type: none"> Insecure group reported significantly higher stress levels prior to MBSR participation ($P < .05$) Both groups showed significant pre–post declines in perceived stress ($P < .05$) Insecure group reported marginally lower perceived stress scores following MBSR participation ($P = .06$) Significant reductions in symptoms of stress ($P < .01$) and mood disturbance ($P < .01$), as well as increases in mindfulness ($P < .01$), spirituality ($P < .01$), and self-compassion ($P < .01$) were observed postintervention Significant increase seen in 2 measures of empathy ($P < .01$)
2010	Birnie, Speca, and Carlson ^{66/} Canada	Pretest–posttest design (n = 41), sample consisted of recruited participants from University of Calgary's Continuing Education Faculty	24 to 77 years, with mean of 47.4 years	Mindfulness-Based Stress Reduction	8 weekly 90-minute sessions, 45 minutes a day practicing methods taught in class [12 hours of instruction + home practice]	Self-Compassion Scale	<ul style="list-style-type: none"> Interpersonal Reactivity Index Mindful Attention Awareness Scale Symptoms of Stress Inventory Profile of Mood States Functional Assessment of Chronic Illness Therapy–Spiritual Well-being Depression Anxiety Stress Scale
2010	Gold, Smith, Hopper, Herne, Tansey, and Hurland ^{67/} United Kingdom	Pretest–posttest design (n = 11), sample consisted of teachers recruited from local suburban primary schools	Late 20s to late 50s, one male and 10 females	Mindfulness-Based Stress Reduction	8 weekly 2.5-hour classes, 5-hour “silent day” retreat between 5th and 6th week of program, 45 minutes a day/6 days a week practicing methods taught in class [27	Depression Anxiety Stress Scale	<ul style="list-style-type: none"> Significant improvements for most participants for depression and stress levels ($P = .02$)

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Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
					hours of instruction + home practice]		
2010	Martin-Asuero and Garcia-Banda ⁶⁰ /Spain	Pretest–posttest design (n = 29), sample consisted of health professionals recruited in various hospitals and primary care centers	Mean age 41.10 years	Mindfulness-Based Stress Reduction	8 weekly 2.5-hour classes, one additional 8-hour session [28 hours]	<ul style="list-style-type: none"> Global Problem scale item from Fear Questionnaire Kentucky Inventory of Mindfulness Scale Symptom Checklist-90-Revised 	<ul style="list-style-type: none"> Significant improvements on 2 of 4 dimensions of Mindfulness Skills Inventory ($P < .05$) 35% reduction of distress ($P = .016$), 30% reduction in rumination ($P = .010$), 20% decrease in negative affect ($P = .002$)
2011	Geary and Rosenthal ⁶⁸ /United States	Pre–post design (n = 153), experimental (n = 59) and control (n = 94) groups, sample consisted of health care providers	Mean age 48 ± 9.6 in experimental group, 42 ± 8.7 in control group	Mindfulness-Based Stress Reduction	8 weekly 3-hour classes, 8-hour retreat sometime between 5th and 7th week of program [32 hours]	<ul style="list-style-type: none"> Survey of Recent Life Experiences and Perceived Stress Scale Positive and Negative Affect Scale Emotional Control Questionnaire Global Evaluation of Intervention Perceived Stress Scale 	<ul style="list-style-type: none"> These benefits lasted during 3-month follow-up Decrease in distress significantly related to other 2 variables Significant reduction in measures of stress, sustained over 12 months
2011	Greeson, Webber, Smoski,	Pretest–posttest design, recruited from self-pay MBSR program (n = 279)	20 to 77 years, mean age 45.0 ± 11.6 years	Mindfulness-Based Stress Reduction	8 weekly 2.5-hour classes, one additional 8-hour session [28 hours]	<ul style="list-style-type: none"> Short Form-36 Symptom Checklist-90-Revised Daily Spiritual Experiences Scale 5-minute measure of Pulse Rate Coherence Cognitive and Affective Mindfulness Scale-Revised 	<ul style="list-style-type: none"> Significant increases in daily spiritual experiences, sustained over 12 months Using measure of pulse-rate variability was not clinically reliable measure of stress Changes in spirituality ($P = .001$) and mindfulness ($P < .001$)

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Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
	Brantley, Ekblad, Suarez, and Wolever ⁶⁹ / United States	with 180 participating in postcourse survey assessment		Stress Reduction			were significantly related to improvement in mental health ($P = .017$)
						<ul style="list-style-type: none"> • Daily Spiritual Experiences Scale • Short Form-12 Survey • Baseline survey asking extent of expectations to benefit from Mindfulness-Based Stress Reduction 	<ul style="list-style-type: none"> • Greater expectancy to benefit from Mindfulness-Based Stress Reduction was significantly associated with greater increases in postintervention mindfulness ($P = .005$)
2011	Shapiro, Brown, Thoresen, and Plante ⁷⁰ / United States	Randomized control trial ($n = 30$), experimental ($n = 15$) and wait-list control ($n = 15$) sample consisted of undergraduate students at a small private university	18 to 24 years (mean age 18.73 ± 1.29 years)	Mindfulness-Based Stress Reduction	8 weekly 2.5-hour classes, one additional 8-hour session [28 hours]	<ul style="list-style-type: none"> • Mindfulness-Based Stress Reduction • Mindful Attention Awareness Scale • Reflection Ruminations Questionnaire • Perceived Stress Scale 	<ul style="list-style-type: none"> • Mindfulness-Based Stress Reduction had significant effects on trait mindfulness ($P < .05$), subjective well-being ($P < .01$), and empathy ($P < .02$) after treatment • Mindfulness-Based Stress Reduction participants reported larger declines in stress ($P < .10$) and significantly larger increases in ATHS hope ($P < .01$) at 12-month follow-up • MBSR participants with higher levels of pretreatment mindfulness showed larger increases in mindfulness ($P < .01$), subjective well-being ($P < .005$), empathy ($P < .03$), and hope ($P < .008$) and larger declines in perceived stress ($P < .04$) at 12-month follow-up
						<ul style="list-style-type: none"> • Subjective Well-being 	

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Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
2012	Goodman and Schorling ⁷¹ / United States	Pretest–posttest observational design (n = 93), sample consisted of health care providers who practiced in university and community settings		Mindfulness-Based Stress Reduction	8 weekly 2.5-hour classes, one additional 7-hour silent retreat between 6th and 7th class, 45 minutes a day/6 days a week practicing methods taught in class [27 hours of instruction + home practice]	<ul style="list-style-type: none"> Positive And Negative Affect Scale Self-Compassion Scale Adult Dispositional Hope Scale Interpersonal Reactivity Index Heartland Forgiveness Scale Maslach Burnout Inventory 	<ul style="list-style-type: none"> Emotional exhaustion scores ($P < .003$), depersonalization scores ($P < .004$), and personal accomplishment scores ($P < .001$) improved significantly from pre- to postintervention Mental well-being improved significantly ($P < .001$) from pre- to postintervention No significant changes in Short Form-12 item version 2 physical health scores Differences in pre and post scores greater for physicians than other health care providers Significantly greater increase in mindfulness, self-compassion in experiential group
2012	Robins, Keng, Ekblad, and Brantley ⁷² / United States	Randomized controlled trial (n = 56), experimental (n = 20) and wait-list control group (n = 21)	21 to 87 years (mean age 46.25 ± 12.97 years)	Mindfulness-Based Stress Reduction	8 weekly 2.5-hour classes, one additional 7-hour silent retreat between 6th and 7th class, 45 minutes a day/6 days a week practicing methods taught in class [27 hours of instruction + home practice]	<ul style="list-style-type: none"> Five Facet Mindfulness Questionnaire Cognitive Failures Questionnaire 	<ul style="list-style-type: none"> Significantly greater decrease in absent-mindedness, anger suppression, aggressive anger expression, fear of emotions, difficulties regulating emotions, and worry

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Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
2013	Barbosa, Raymond, Zlotnick, Wilk, Toomey, and Mitchell ^{73/} United States	Nonrandomized pre- and posttest quasi-experimental design (n = 31), experimental group (n = 16) and control group (n = 15) drawn from a sample of graduate health care students	Experimental group: 23-30 years, mean age of 26.6; Control group: 22-30 years, mean age of 24.6 years	Mindfulness-Based Stress Reduction	8 weekly 2.5-hour classes, one additional 7-hour silent retreat during 6th week, 35 minutes a day/6 days a week practicing methods taught in class [27 hours of instruction + home practice]	<ul style="list-style-type: none"> • Difficulties in Emotional Regulation Scale • Affective Control Scale • Ruminative Responses Scale • Penn State Worry Questionnaire • Spielberger Anger Expression Scale • Self-Compassion Scale • Marlowe-Crowne Social Desirability Scale—Short Form C • Burns Anxiety Inventory 	<ul style="list-style-type: none"> • Nonsignificant trend for greater decrease in rumination in experimental group • Rumination changes did not significantly differ between groups • Significant decrease in anxiety at 8 and 11 weeks compared with baseline ($P < .001$ and $P < .01$, respectively)
2013	Bazarko, Cate, Azocar, and Kreitzer ^{74/} United States	Nonrandomized pre- and posttest design (n = 36), sample consisted of nurses in health care setting	Mean age of 52.2 years	Mindfulness-Based Stress Reduction	6 weekly 1.5-hour teleconference calls, email contact with instructor between sessions, one additional full-day retreat after 8th week, 25-30 minutes a day/6 days a week practicing methods taught in class [16 hours of instruction + home practice]	<ul style="list-style-type: none"> • Jefferson Scale of Physician Empathy • Maslach Burnout Inventory • Perceived Stress Scale 	<ul style="list-style-type: none"> • Significant increase in empathy at 8 weeks ($P < .0096$) • No significant differences in burnout scores at 8 and 11 weeks between experimental and control groups • Significant improvements in general health ($P < .01$), perceived stress ($P < .001$), decreased work burnout ($P < .001$) between baseline and postintervention

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Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
2013	Bergen-Cico, Possemato, and Cheon ⁶³ / United States	Quasi-experimental pretest–posttest design (n = 119), experimental group (n = 72) were undergraduate students enrolled in elective health courses and parallel control group (n = 47) were undergraduate students randomly selected from students enrolled in other elective health courses on addictive behaviors	Experimental group: mean age of 21.5 ± 1.0; Control group: mean age of 21.1 ± 1.4 years	Mindfulness-Based Stress Reduction	5 weekly 2-hour classes [10 hours]	<ul style="list-style-type: none"> Jefferson Scale of Physician Empathy Self-Compassion Scale Kentucky Inventory of Mindfulness Skills 	<ul style="list-style-type: none"> Improvements sustained 4 months later No significant changes from time 8 weeks to 11 weeks, suggesting maintenance over 4 months Participants who maintained Mindfulness-Based Stress Reduction practice were significantly higher in overall self-compassion at 4 months ($P < .001$) No significant changes among parallel control group for mindfulness or self-compassion measures
2013	De Vibe, Solhaug, Tyssen, Friborg,	Randomized, controlled design (n = 288), experimental group (n = 144) and control	Experimental group: mean age of 23.6 ± 4.7; Control group:	Mindfulness-Based	8 weekly 2.5-hour classes, one additional 7-hour silent retreat between 6th and 7th	<ul style="list-style-type: none"> PHLM Self-Compassion Scale Spiegelberger State-Trait Anxiety Inventory-Trait Form Y-2 General Health Questionnaire 	<ul style="list-style-type: none"> Significant pre- to post increases in mindfulness ($P \leq .001$) and self-compassion ($P \leq .001$) measures in experimental group Trait anxiety declined for treatment group, whereas it increased slightly for control group, but did not yield significant results No significant reductions in student stress or student burnout

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Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
	Rosenvinge, Sørlie, and Bjørndal ⁷⁵ / Norway	group (n = 144) drawn from a sample of undergraduate students from 2 universities	mean age of 24.0 ± 5.7 years	Stress Reduction	week, 45 minutes a day/6 days a week practicing methods taught in class [27 hours of instruction + home practice]	<ul style="list-style-type: none"> Maslach Burnout Inventory (Student version) Perceived Medical School Stress Subjective Well-Being Five Facet Mindfulness Questionnaire Symptom Checklist-90 	<ul style="list-style-type: none"> Significant effects on main outcome measures (mental distress and well-being) compared with control group ($P < .001$) Significant change in mindfulness measures in experimental group ($P > .01$)
2013	Flook, Goldberg, Pinger, Bonus, and Davidson ⁷⁶ / United States	Randomized, controlled design (n = 18), experimental group (n = 10) and control group (n = 8) drawn from a sample of elementary school teachers from different public elementary schools	25-56 years; Experimental group: mean age of 46.70 ± 6.95; Control group: mean age of 38.50 ± 11.49 years	Mindfulness-Based Stress Reduction	8 weekly 2.5-hour classes, one additional 6-hour day-long immersion, 45 minutes a day/6 days a week practicing methods taught in class [26 hours of instruction + home practice]	<ul style="list-style-type: none"> Five Facet Mindfulness Questionnaire Self-Compassion Scale Maslach Burnout Inventory–Educators Survey Classroom Assessment Scoring System 	<ul style="list-style-type: none"> Intervention group showed significant improvements on several psychological symptoms ($P = .005$), increase in mindfulness ($P = .032$), increase in self-compassion ($P = .008$) and decreases in burnout ($P = .038$) Intervention group showed significant improvements in observer-rated classroom behavior ($P = .046$) and affective attentional bias ($P = .012$) Control group showed significant decrease in morning cortisol ($P = .048$), marginally significant increase in burnout ($P = .051$)

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Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
2013	Foureur, Besley, Burton, Yu, and Crisp ⁷⁷ / Australia	Pretest–posttest design (n = 40), sample consisted of 20 nurses and 20 midwives	Mean age 10.8 years (SD = 0.41, range = 10–11 years)	Mindfulness-Based Stress Reduction	Adapted 1-day MBSR workshop, CD recorded by workshop facilitator for daily mindfulness sessions of 20 minutes for 8 weeks [8 hours of instruction + home practice]	<ul style="list-style-type: none"> Cortisol levels in saliva samples Cambridge Neuropsychological Test Automated Battery Rapid Visual Information Processing Task Affective Go/No-Go Weekly practice logs General Health Questionnaire-12 	<ul style="list-style-type: none"> Significant improvements in General Health Questionnaire-12 measures ($P = .011$ and $P = .031$); SOC measures—orientation to life ($P = .009$), comprehensibility ($P = .012$), and manageability ($P = .075$); DASS measures—stress ($P = .004$)
2013	Krusche, Cyhlarova, and Williams ⁷⁸ / United Kingdom	Pretest–posttest design (n = 273), sample consisted of self-referrals to online course	20–80 years, mean age 47.7 ± 11.98 years	Mindfulness-Based Stress Reduction	<ul style="list-style-type: none"> Ten interactive sessions where participants learn to use formal meditation skills and informal mindfulness techniques through videos, assignments, and emails Course last minimum of 4 weeks One formal meditation exercise using audio and video clips supplied and one informal practice every day of week [no schedule reported] 	<ul style="list-style-type: none"> Sense of Coherence–Orientation to Life Depression Anxiety Stress Scale Perceived Stress Scale Generalized Anxiety Disorder Assessment-7 Patient Health Questionnaire-9 	<ul style="list-style-type: none"> Significant difference in mean Perceived Stress Scale scores from pre- to postintervention ($P < .001$), with greater decreases from post to 1-month follow-up ($P < .001$) Significant difference in mean Generalized Anxiety Disorder Assessment-7 scores from pre- to postintervention ($P < .001$), with greater decreases from post to 1-month follow-up ($P < .001$) Significant difference in mean Patient Health Questionnaire-9 scores from pre- to postintervention ($P < .001$), with greater decreases from post to 1-month follow-up ($P < .005$)

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Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
2013	Nyklíček, Mommersteeg, Van Beugen, Ramakers, and Van Boxtel ⁷⁹ / Netherlands	Randomized controlled trial (n = 88), experimental group (n = 44) and control group (n = 4) drawn from a sample of community residents	Mean age 46.1 ± 10.6 years	Mindfulness-Based Stress Reduction	8 weekly 2.5-hour classes, 45 minutes a day/6 days a week practicing methods taught in class [20 hours of instruction + home practice]	<ul style="list-style-type: none"> Perceived Stress Scale 	<ul style="list-style-type: none"> Treatment group showed larger pre- to posttest decreases in overall systolic blood pressure (P = .029) and diastolic blood pressure (P = .002) Treatment group exhibited smaller systolic blood pressure and diastolic blood pressure stress-related changes from pre- to posttest (P = .007) No significant effects obtained on other physiological measures
						<ul style="list-style-type: none"> Positive And Negative Affect Scale 	
						<ul style="list-style-type: none"> Heart Rate Variability using EKG 	
						<ul style="list-style-type: none"> Blood pressure using PORTAPRES 	
						<ul style="list-style-type: none"> Heart Rate Variability using cortisol, very low frequency band, low frequency band, high frequency band, and low frequency/high frequency ratio 	

Abbreviations: MBSR, mindfulness-based stress reduction; PHLM = Philadelphia mindfulness scale; SOC = sense of coherence; DASS = depression anxiety stress scale.

The duration of mindfulness-based stress reductions interventions varied from 8 hours to 32 hours plus home practice. The mode of duration was 4 weeks, 5 weeks, and 8 weeks ($n = 4$). The most common outcome measure was score on a perceived stress scale, which was used by 7 studies,^{60,65,68,70,74,78,79} as well as scores on the self-compassion scale, which was used by 6 studies.^{63,66,70,72,74,76} Maslach's Burnout Inventory was most commonly used to measure perceived burnout stress.^{71,73,75,76} Other common measures used were the Five Facet Mindfulness Questionnaire^{72,75,76} and the Positive and Negative Affect States survey.^{60,70,79} Psychological outcome measures were used by all studies. Physiological outcomes measures were examined along with psychological measures by 3 interventions^{68,76,79} and included pulse rate coherence, salivary cortisol, blood pressure, and heart rate variability.

Discussion

The aim of this review was to look studies published from January 2009 to January 2014 and examine whether mindfulness-based stress reduction can be an alternative and complementary therapeutic approach for stress reduction among healthy individuals. A total of 17 studies met the inclusion criteria. The first question that this review addressed was, "Has mindfulness-based stress reduction been found to be efficacious in decreasing stress in otherwise healthy individuals since the 2008 review?" From the 17 studies, a majority ($n = 15$) demonstrated positive changes in psychological or physiological outcome measures related to stress,^{60,63,65-71,73,74,76-79} whereas 2 studies had mixed results.^{72,75} These findings are in consonance with the previous review published in 2009 that found positive results. Of the 15 studies that have shown positive results, only 2 have used randomized controlled designs.^{76,79} This type of design is considered the most rigorous as it includes pretests and posttests, randomizes the participants or their group into a control and an experimental group, and minimizes potential threats to internal and external validity. In this design, changes in pretest and posttest scores can be contrasted by levels of intervention.

While the pretest–posttest design is the least costly and simplest to conduct, this design is unable to minimize threats to internal validity such as maturation and history due to the lack of a control group for comparison. Without having a control group, the findings from these studies must be interpreted with caution. Future studies should use the more robust randomized control design or, when it is not feasible, the group randomized control design.

The second and third questions this review examined were, "Is there sufficient data available to draw conclusions regarding the efficacy of mindfulness-based stress reduction in stress management?" and "What are the methodological limitations of present research studies and how can these be addressed in future research?" The review looked at 17 studies of which 5 were randomized controlled designs. Based on these studies, some conclusions can be made but one would need to consider the limitations.

Besides the design type, several other limitations need to be kept in mind while interpreting the efficacy of mindfulness-based stress reduction in stress management. The majority of included studies were of lower quality. This could result in potential unobserved biases that reduce the significance of examined findings. The main methodological shortcomings were small sample size, self-selection, nonrandomization, and the impracticality of conducting meditation studies under a double-blind condition. However, all the reviewed studies provided significant results in the same direction, emphasizing the nonspecific and potentially specific effect of mindfulness-based stress reduction for stress reduction.

A second limitation is the administration of self-rated scales, which could be influenced by social desirability. A third limitation was that people in all studies were most often Caucasian females, thus limiting the generalizability to minority populations, and enhancing the necessity of further research in more diverse populations samples. An important final limitation is the differing durations of the studies and partially differing study designs, which could influence final values. Nonetheless, apart from the modified version for the online participants, and the shortened program for nurses/midwives and undergraduate students, mindfulness-based stress reduction techniques, programs, and lessons with home practice duration were not significantly different across the studies.

The sample sizes have generally been small with only 3 studies having sample size more than 155. Power calculations and sample size justifications are generally missing from most of the reviewed studies. There have been no large-scale, longitudinal studies that have been conducted with this research problem. Future research should look at the possibility of conducting large-scale, longitudinal studies. If the customary mindfulness-based stress reduction program is going to be modified for shorter duration interventions, a standardized shortened version should be developed.

The final question that this review aimed at answering was, "What are the common outcome measures measured by studies and which ones are more important for future studies?" Both psychological and physiological measures were used by the studies though psychological measures were more common and were used by all studies. The most common outcome measure was the score on a perceived stress scale, which was used by 7 studies and was measured mainly by Cohen's perceived stress scale.³⁴ Cohen's perceived stress scale is under public domain and is certainly a useful measure to use in studies examining mindfulness-based stress reduction and stress. The Self-Compassion Scale is also a useful measure for examining mindfulness, which is one of the main tenants of self-compassion. The common physiological measures that can be used by future studies are heart rate (and its variability), blood pressure, and, if possible, salivary cortisol.

Conclusions

Stress is an imminent public health problem and one of the approaches to address this problem is through mindfulness-

based stress reduction. A total of 17 interventions from January 2008 to December 2013 looked at mindfulness-based stress reduction and its efficacy in decreasing stress in healthy individuals. Of these reviewed studies, all interventions were able to find some positive effects in psychological or physiological outcome measures related to stress. Despite the limitations of not all studies using randomized controlled design, having smaller sample sizes, and having different outcome measures, mindfulness-based stress reduction is a promising modality for stress management among healthy individuals. All practitioners teaching stress management must include mindfulness-based stress reduction as one of the approaches for stress reduction.

Authors' Note

This work was performed by Dr Manoj Sharma and Sarah E. Rush.

Author Contributions

MS conceptualized the study, developed the inclusion criteria, collected the data, developed the table, analyzed the data, and prepared the article. SER developed the inclusion criteria, collected the data, developed the table, analyzed the data, and prepared the article.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethical Approval

This study did not warrant institutional review board review as no human subjects were involved.

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