

Yoga as an Alternative and Complementary Approach for Stress Management: A Systematic Review

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Abstract

Stress has become a global public health problem. Yoga offers one possible way of reducing stress. The purpose of this study was to look at studies from 2011 to May 2013 and examine whether yoga can be an efficacious approach for managing stress. A systematic search of Medline, CINAHL, and Alt HealthWatch databases was conducted for quantitative articles involving all schools of yoga. A total of 17 articles met the inclusion criteria. Six of these were from the United States, 3 from India, 2 from the United Kingdom, and 1 each from Australia, Brazil, Germany, Iraq, Sweden, and Taiwan. Of the 17 studies, 12 demonstrated positive changes in psychological or physiological outcomes related to stress. Despite the limitations, not all studies used a randomized controlled design, had smaller sample sizes, had different outcomes, had nonstandardized yoga intervention, and had varying lengths, yoga appears to be a promising modality for stress management.

Keywords

yoga, mind–body interventions, stress, anxiety

Received May 28, 2013. Accepted for publication August 1, 2013.

Introduction

Stress is a widely prevalent phenomenon in modern society and has become a global public health problem.^{1,2} It may account for deprived quality of life, lower mental health, reduced work efficiency, greater suffering, and increased physician visits besides being a risk factor for several chronic diseases such as coronary heart disease, hypertension, diabetes mellitus, and others.³ Stress is conceptualized from 3 perspectives²: (a) *response based*, which has been defined from a physiological point of view by a lead proponent of this approach, Hans Selye,⁴ as “a nonspecific response of the body to any demand made upon it”; (b) *event based*, which is based on the work of Thomas Holmes and Richard Rahe⁵ and emphasizes the role of life events as being stressful; and (c) the *interactional model of stress*, which is based on the work of Richard Lazarus⁶ and emphasizes problem focused and emotion focused coping in response to stressors. Based on these perspectives, stress can be conceptualized as the physiological and psychological response (including behaviors) as a result of encountering stressors, interpreting them, and making judgments about controlling or influencing the outcomes of these events.⁷

To manage or reduce stress, several approaches are popular. These include (a) enhancing cognitive awareness of stressors and coping⁶; (b) relaxation techniques such as biofeedback, progressive muscle relaxation, autogenic training, yoga, meditation, visual imagery, self-hypnosis²; (c) improving interpersonal

communication by techniques such as assertiveness and understanding behavioral style; (d) learning anger management by techniques such as active listening⁸ and transactional analysis⁹; (e) anxiety reduction techniques such as rational emotive therapy,¹⁰ gestalt therapy,¹¹ and systematic desensitization¹²; (f) incorporating healthy eating and regular physical activity²; and (g) managing time.² Not many studies have been done to ascertain the relative efficacy of these techniques or even the efficacy of these individually. One of the techniques with which some research has been done is yoga.

The word *yoga* is derived from the Sanskrit word meaning *union*. It is an ancient system of physical and psychic practice that originated during the Indus Valley civilization in South Asia. The first written records of this methodology appeared around 200 BC in *Yogasutra* of Patanjali.¹³ The system consisted of the 8-fold path or *Asthangayoga*. In contemporary literature, yoga has been described in several ways. In a more modern context, yoga has been defined as “a systematic

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practice and implementation of mind and body in the living process of human beings to keep harmony within self, within society, and with nature."^{14,15}

The traditional practice of yoga was quite rigorous, arduous, entailed lifelong devoted practice, and adherence to strict austerities. Today, many schools of yoga have simplified the techniques making these more suitable for users in different walks of life. The 8 conventional steps of *Asthangayoga* consist of *Yama* (rules for living in society), *Niyama* (self-restraining rules), *Asana* (low physical impact postures), *Pranayama* (breathing techniques), *Pratihara* (detachment of the mind from senses), *Dharana* (concentration), *Dhyana* (meditation), and *Samadhi* (complete union with super consciousness).² Today, various schools of yoga use one or more of these techniques.

A literature review was published in 2011 that looked at all the randomized controlled trials and clinical trials till that time which has studied the effects of yoga on stress management.¹⁶ The study summarized the results from 8 such trials and found positive effects of yoga though there were methodological shortcomings and the number of studies was too small. Since 2011, several additional studies have been published in this area. Hence, the purpose of this review was to look at these additional studies and examine whether yoga can be an alternative and complementary approach for managing stress.

Questions being addressed in this review include the following: Has yoga been found to be efficacious in alleviating stress in otherwise healthy individuals since the 2011 review? Is there sufficient data available to draw conclusions regarding the efficacy of yoga in stress management? What are the methodological limitations of the 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 yoga interventions for managing stress 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) the study was conducted between January 2011 and May 2013; (d) include any form or school of yoga as an intervention; (e) use any quantitative study design for evaluation; and (f) measure at least one of the following psychological or physiological outcomes: perceived stress, positive psychological attitudes, anxiety, heart rate, blood pressure, serum interleukin, salivary cortisol, or blood lipids. Articles were excluded from this review based on the following criteria: (a) studies that did not evaluate the intervention or implemented a quantitative design; (b) did not sample apparently healthy participants; (c) did not include selected outcome measures; and (4) did not index in any of the following databases: CINAHL, 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 "Yoga AND Stress" or "Yoga AND Stress Program" or "Yoga AND Stress Intervention" for the time period January 2011 to May 2013.

Using the above-mentioned terms/phrases, 307 articles were returned: 129 articles from Medline, 36 from Alt HealthWatch, and 142 from CINAHL. Phase II included preliminary distillation of the articles by eliminating duplicates ($n = 41$), and review/discussion/other articles ($n = 225$), and studies not incorporating yoga in the intervention ($n = 1$). In Phase III, comprising manuscript review of the remaining articles ($n = 22$), 3 studies did not have quantitative results or did not incorporate at least one of the following outcome measures: perceived stress, positive psychological attitudes, anxiety, heart rate, blood pressure, serum interleukin, salivary cortisol, or blood lipids; one study did not mention yoga specifically; and one study did not involve healthy participants. 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 2011. 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 ($n = 6$),^{17,20,24,29,30,31} followed by India ($n = 3$)^{18,26,28} and the United Kingdom ($n = 2$).^{19,21} One study each was implemented in Australia,²² Brazil,²⁵ Germany,²³ Iraq,²⁷ Sweden,³³ and Taiwan.³² Of the 17 interventions, 10 were randomized controlled designs,^{18,19,21,23,26-28,30,31,33} 3 used group randomized controlled design,^{24,29,32} 2 used quasi-experimental designs,^{22,25} 1 used a pretest–posttest design,²⁰ and 1 was a comparative study between beginner and advanced practitioners.¹⁷ The mean sample size calculated for all 17 studies in this review was 67.76, with a standard deviation of 46.87 and range of 20 to 205. Total sample sizes (n) were typically between 30 to 100, with 2 studies having sample sizes less than 30,^{22,31} and 2 studies had sample sizes more than 100.^{29,30} The sites of the yoga intervention for stress management were in colleges/universities ($n = 5$),^{18-20,26,28} community settings ($n = 3$),^{17,22,32} worksites ($n = 2$),^{21,30} with military personnel ($n = 2$),^{25,27} and 1 each in elementary school,²⁹ middle school,³¹ high school,²⁴ and primary health care center.³³ The school of yoga was not identified by 6 studies.^{18,22,25,26,31,33} It was identified as Hatha yoga by 3 studies,^{17,27,32} as Dru yoga by 2 studies,^{19,21} and there were 1 each of Bikram yoga,²⁰ Iyengar yoga,²³ Kripalu yoga,²⁴ Sudarshan Kriya,²⁸ Mindful yoga,²⁹ and Viniyoga.³⁰

The duration of yoga interventions varied from 30 minutes²² to 6 months.²⁵ The mode of duration was 8 weeks ($n = 4$)^{20,21,29,32} and 12 weeks ($n = 4$).^{18,23,30,33} The most common outcome measure was score on a perceived stress scale, which was used by 10 studies.^{17,20-24,29,30,32,33} Cohen's Perceived Stress Scale was most

Table 1. Summary of Yoga Interventions for Stress Done Between 2011 and May 2013 (n = 17).

Year	Authors/ Country	Design & Sample	Age	Intervention Modality	Intervention Dosage	Outcome measures	Salient Findings
2011	Brisbon & Lowery ^{17/} U.S.A	Comparison between beginner (n=24) and advanced practitioners (n=28) of Hatha yoga	21 to 65 years, with mean of 43.8 years	Hatha yoga practice	1-5 years (beginner) & 6 to 30 years (advanced)	Levels of mindfulness using Mindful Attention Awareness Scale Levels of stress using Perceived Stress Scale	Advanced practitioners had significantly higher mindfulness scores (p < 0.05) and significantly lower stress scores (p < 0.05) when compared to beginner practitioners
2011	Gopal, Mondal, Gandhi, Arora & Bhattacharjee ^{18/} India	Randomized control design with n=60 medical student volunteers	All girls between 17 to 20 years	Combination of low physical impact postures, breathing and meditation	35 minutes daily for 12 weeks <ul style="list-style-type: none"> • Yogic prayer 2 min. • Sukshma Vyayama (micro exercises) 6 min. • Shula Vyayama (macro exercises) 4 min. • Asanas (postures) 12 min. • Pranayama 4 min. • Dhyana (meditation) 5 min. 	Heart rate Respiratory rate Blood pressure Rate pressure product Global Assessment of Recent Stress Scale State trait anxiety inventory for adults Serum cortisol Serum Interleukin (IL-4) Serum Interferon (IFN- γ)	No significant differences were observed in physiological parameters during the examination stress in the yoga group, while there was an increase in these in the control group. Serum cortisol levels during examination stress in control group was higher (187.16%) and statistically significant (p<0.001) than in the yoga group (93.1% increase)
2011	Hartfield, Havenhand, Khalsa, Clarke, & Krayner ^{9/} U.K.	Randomized wait list control design with n = 48 employees at a British University	Mean age 39.3 years	Dru yoga consisting of activation exercises, energy block release sequences, postures and relaxation	60 minute per week for 6 weeks	Profile of Mood States – Bipolar Inventory of Positive Psychological Attitudes	Yoga group had improved scores for seven out of eight domains on Profile of Mood States and Inventory of Positive Psychological Attitudes in comparison to wait list group Yoga group reported greater self confidence in combating stressful situations than the wait list group
2011	Hewett, Ransdell, Gao, Petlichkoff, & Lucas ^{20/} U.S.A	Pretest posttest design with n=80 of which 51 completed the study drawn from a large University	20-54 years (mean, 31.57 years)	Bikram yoga (26 asanas that take place in a heated room)	Minimum of 20 sessions over 8 weeks	Changes in mindfulness (Five-Facet Mindfulness Questionnaire) Perceived stress (Perceived Stress Scale) Physical fitness (resting heart rate, 1-mile walk, sit-and-stand, total body rotation, and single-leg balance) Perceived stress using Perceived Stress Scale Roland Morris Disability Questionnaire score Positive and Negative Affect Scale score	Improvement in mindfulness, perceived stress, cardiorespiratory endurance, flexibility and balance (p < 0.01) from pretest to post test Mindfulness was negatively correlated with perceived stress (r = -0.43, p < 0.01)
2012	Hartfield, Burton, Rycroft-Malone, Clarke, Havenhand, Khalsa, & Edwards ^{21/} U.K.	Randomized control design, n = 37 in each group, 33 in experimental and 26 in control group completed. Sample drawn from a British local government authority	46.1 for experimental group and 43.6 for control group	Dru Yoga consisting of activation exercises, energy block release sequences, postures and relaxation	50 min per week x 8 weeks + 20 min DVD based home practice twice a week		Significant reduction in perceived stress (p < 0.01) and back pain (p < 0.01) was found for yoga group Significant improvement in psychological well-being was found for yoga group

(continued)

Table 1. (continued)

Year	Authors/ Country	Design & Sample	Age	Intervention Modality	Intervention Dosage	Outcome measures	Salient Findings
2012	Melville, Chang, Colagiuri, Marshall, & Cheema ^{22/} Australia	Within-subjects crossover design with three conditions: yoga, guided meditation, and control each separated by 24 hours; n=20	Mean age 39.6 years \pm 9.5	Yoga postures included side bend, forward bend, back bend, arms above head and extended; each posture held for six full breaths followed by relaxation. Meditation involved deep breathing, visualization, and alleviating internal dialogue	15 min of gentle yoga postures seated on a chair; 15 min of guided meditation;	Perceived stress on a 100 mm visual analogue scale Blood pressure Heart rate Respiration	Yoga and meditation significantly reduced perceived stress compared to control Yoga increased heart rate compared to control ($p < 0.05$). Meditation reduced heart rate compared to control ($p < 0.05$). Respiration rate reduced during yoga and meditation compared to control ($p < 0.05$). Systolic and diastolic blood pressure reduced during meditation compared to control ($p < 0.05$)
2012	Michalsen, Jettler, Brunnhuber, Ludtke, Bussing, FraukeMusial, Dobos, & Kessler ^{23/} Germany	Randomized control trial with three groups: (1) yoga group 1 (n = 24) with 12 sessions x 3 months; (2) yoga group 2 (n = 24) with 24 sessions x 3 months; (3) wait list control group (n = 24). Sample consisted of community dwelling women volunteers	19 to 52 years (mean age 39.6 \pm 8.3 years)	Iyengar yoga with back bends, standing poses, and forward bends and inversions	Group 1: Twelve 90 minute sessions over 3 months Group 2: 24 sessions over 3 months	Cohen Perceived Stress Scale score Spielberger State-Trait Anxiety Inventory score Profile of Mood States score Brief Symptom Inventory Center for Epidemiological Studies Depression Inventory Quality of life by SF 36 Bf-S Zerssen wellbeing scale	Significant improvement in yoga groups at 3 months for perceived stress ($p = 0.003$) State anxiety decreased in yoga groups ($p = 0.021$) and so did trait anxiety ($p = 0.003$) For yoga groups improvement in depression ($p = 0.008$), Quality of life ($p = 0.012$), and mood states ($p = 0.007$)
2012	Noggle, Steiner, Minami, & Khalsa ^{24/} U.S.A.	Group randomized controlled trial: yoga group (n=36) or control group (n=15) drawn from high school	Mean age for yoga group 17.1 years (s.d. = 0.6), control group 17.3 years (s.d. = 0.8)	Kripalu yoga comprising of postures, breathing, relaxation, and meditation	2-3 yoga sessions a week for 10 weeks (total 28 sessions)	Perceived Stress Scale Profile of Mood States short form Inventory of Positive Psychological Attitudes Resilience scale State trait Anger Expression Inventory Child Expression and Mindfulness Measure	Perceived stress did not show significant change Total mood disturbance decreased in yoga group ($p < 0.15$) Tension-anxiety decreased in yoga group ($p < 0.002$)
2012	Rocha, Ribeiro, Rocha, Sousa, Albuquerque, Ribeiro, & Silva ^{25/} Brazil	Quasi experimental design: the yoga group (n = 17); the control group (n = 19) drawn from Brazilian army	20-40 years old	Yoga not specified	Yoga group: two yoga classes a week plus two physical exercise classes x 6 months Control group: only physical exercises (four classes a week) x 6 months	Beck Depression Inventory Beck Anxiety Inventory Lipp Stress Symptom Inventory Memory tests comprising of short- and long-term memory of word recognition Salivary cortisol	After 6 months yoga group had significantly lower scores for depressive symptoms ($U = 60.0$, $p = .001$). After 6 months yoga group scores for anxiety decreased compared to control group ($U = 39.0$, $p < .001$) After 6 months yoga group performed significantly better compared to controls in the word recognition test in the easy context [$t(34) = 2.11$, $p .05$] and difficult context [$t(34) = 3.53$, $p = .001$] After 6 months, the salivary cortisol increased in control group ($z = -2.41$, $p = .01$) while decreased in the yoga-group ($z = -3.62$, $p < .001$).

(continued)

Table 1. (continued)

Year	Authors/ Country	Design & Sample	Age	Intervention Modality	Intervention Dosage	Outcome measures	Salient Findings
2012	Shankarapillai, Nair, & George ^{26/} India	Randomized controlled design: Yoga group (n =50) and control group (n =50) drawn from a group of dental students performing their first periodontal surgery	Mean age of 22.22 ± 0.58 years	Yoga postures, asanas, (15 min), regulated breathing pranayama, (20 min), exercises for the joints sithlikarana vvyayama, (10 min), & relaxation (15 min)	60-min training	100 mm Visual analog scale for anxiety Spielberger state-trait anxiety inventory	Significant reduction in anxiety on Visual Analog Scale (p <0.05) and state anxiety in yoga group compared to control (p<0.001).
2012	Stoller, Greuel, Cimini, Fowler, & Koomar ^{27/} Iraq	Randomized controlled trial: yoga group (n=35) & control group (n=35) drawn from military personnel who were deployed to Iraq	Mean age of 31.8 years, s.d. 8.05	Sensory-enhanced hatha yoga comprising of asanas, pranayama, relaxation & meditation	75 min classes for 3 consecutive weeks: 7 times/week (minimum 9 sessions required)	Adolescent/ Adult Sensory Profile Spielberger state-trait anxiety inventory Quality of Life Survey	Yoga group showed significant reduction in both state and trait anxiety compared to control group (p < .001) Yoga group showed significantly greater improvement than control group on 16 of 18 variables of the Quality of Life Survey (p <0.05)
2012	Subramanian, Elango, Malligarijunan, Vinod, & Dayalan ^{28/} India	Randomized controlled trial: yoga group (n=22) & control group (n=21) drawn from engineering students undergoing exam stress	Not reported	Sudarshan Kriya comprising of asanas, pranayama, & meditation	Daily for six weeks	Total cholesterol Triglycerides High density lipoproteins (HDL) Low density lipoproteins (LDL) Very low density lipoproteins (VLDL) Hematological parameters	In the yoga group, total cholesterol, triglycerides, and VLDL decreased at 3 and 6 weeks compared to control group (p<0.05) HDL & LDL were unchanged In the yoga group level of lymphocytes increased significantly at three weeks (p<0.01) and six weeks (p<0.01) when compared with control group
2012	White ^{29/} U.S.A.	Randomized, cluster, repeated measures design that randomly assigned fourth and fifth grade girls from two public schools to intervention (n=70) or wait-list control group (n=85)	Mean age 9.9 years (s.d. = 0.720, range 8-11 years).	Mindful Yoga: (1) sitting meditation, (2) body scanning (3) yoga, (4) mindful eating and walking, (5) homework	1 hour per week for 8 weeks	Feel Bad Scale score for perceived stress Schoolagers Coping Strategies Inventory score Score on Global Self-Worth subscale of the Self-Perception Profile for Children Score on Healthy Self-Regulation subscale of the MindfulThinking and Action Scale for Adolescents	No significant differences in perceived stress or coping strategies between groups Both groups increased in self-esteem and self-regulation but there were no differences between groups
2012	Wolever, Bobinet, McCabe, Mackenzie, Fekete, Kusnick, & Baime ^{30/} U.S.A.	Randomized controlled trial with four groups: (1) yoga (n = 76); (2) online mindfulness (n= 50); (3) in-person mindfulness (n =32); (4) control (n = (47) drawn from employees of a national insurance carrier.	Mean age for control group 42.7 (9.7) years; mindfulness group 44.3 (9.4) years and yoga group 41.6 (10.1) years	Viniyoga: Breathing, asanas, & individual adaptation Mindfulness: Stress reduction program	Yoga: 1 hour per week for 12 weeks + Home practice Mindfulness: 14 hours over 12 weeks	Score on Perceived Stress Scale Pittsburgh Sleep Quality Index score Center for Epidemiological Studies Depression Scale Work Limitations Questionnaire score Cognitive and Affective Mindfulness Scale-Revised score Blood pressure Breathing rate Heart rate variability	The yoga group showed greater reduction in perceived stress, F(1, 137) = 8.79, p = .01, and greater reduction in sleep difficulty score F(1, 137) = 5.94, p = .05 in comparison to control group The yoga group showed greater increase in heart rhythm coherence from Baseline in comparison to control group, F(1, 137) =29.77, p = .001

(continued)

Table 1. (continued)

Year	Authors/ Country	Design & Sample	Age	Intervention Modality	Intervention Dosage	Outcome measures	Salient Findings
2013	Hagins, Haden, & Daly ³¹ / U.S.A.	Randomized controlled trial of 6th grade students assigned to either a yoga (n = 15) or control consisting of physical education program (n = 15) utilizing pre- and posttest measures	Mean age 10.8 years (s.d. = .41, range 10-11 years)	Asanas, breathing, seated meditation, guided relaxation, & homework	50 min. session three times per week x 15 weeks	Blood pressure and heart rate following behavioral stressor tasks of mental arithmetic and mirror tracing	No change in systolic (p = 0.470) or diastolic blood pressure (p = 0.312) or heart rate (p = 0.532) for the yoga group compared to control
2013	Huang, Chien, & Chung ³² / Taiwan	Quasi experimental design using an experimental yoga group (n = 30) and a control group (n = 33) drawn from healthy women living in New Taipei City	Mean age for yoga group 46 years (s.d. 4.3) and control 45.6 years (s.d. 4.8)	Hatha yoga comprising of asanas, breathing and meditation	Single 90-minute Hatha yoga class 8-week, 90-minute-class-per-week course	Perceived Stress Scale score Heart rate variability	After a single class, perceived stress scale scores and heart rate variability were significantly lower than control group (p = .001) After 8 weeks yoga no significant differences with regard to perceived stress scale were found After 8 weeks yoga heart rate variability improved
2013	Köhn, Lundholm, Bryngelsson, Anderzén-Carlsson, & Westerdahl ³³ / Sweden	Randomized controlled trial with yoga group (n = 18) and control group (n = 19) drawn from a primary health care center in Sweden	Mean age in control group 52 ± 15 years and yoga group 54 ± 9 years	Yoga consisting of postures, stretching exercises, breathing techniques, mantras, relaxation, and meditation	60 minute session once a week over a 12-week period	Perceived Stress Scale score Level of burnout by Shirom-Melamed Burnout Questionnaire Score on Hospital Anxiety and Depression Scale Visual analogue Scale for pain Insomnia Severity Index score Perception of overall health status using the Euro Quality of Life scale Heart rate Peripheral oxygen saturation Blood pressure Thoracic excursions	Yoga group had significantly greater improvement on general stress level (p < 0.000), anxiety (p < 0.019), and overall health status (p < 0.018) compared to control group

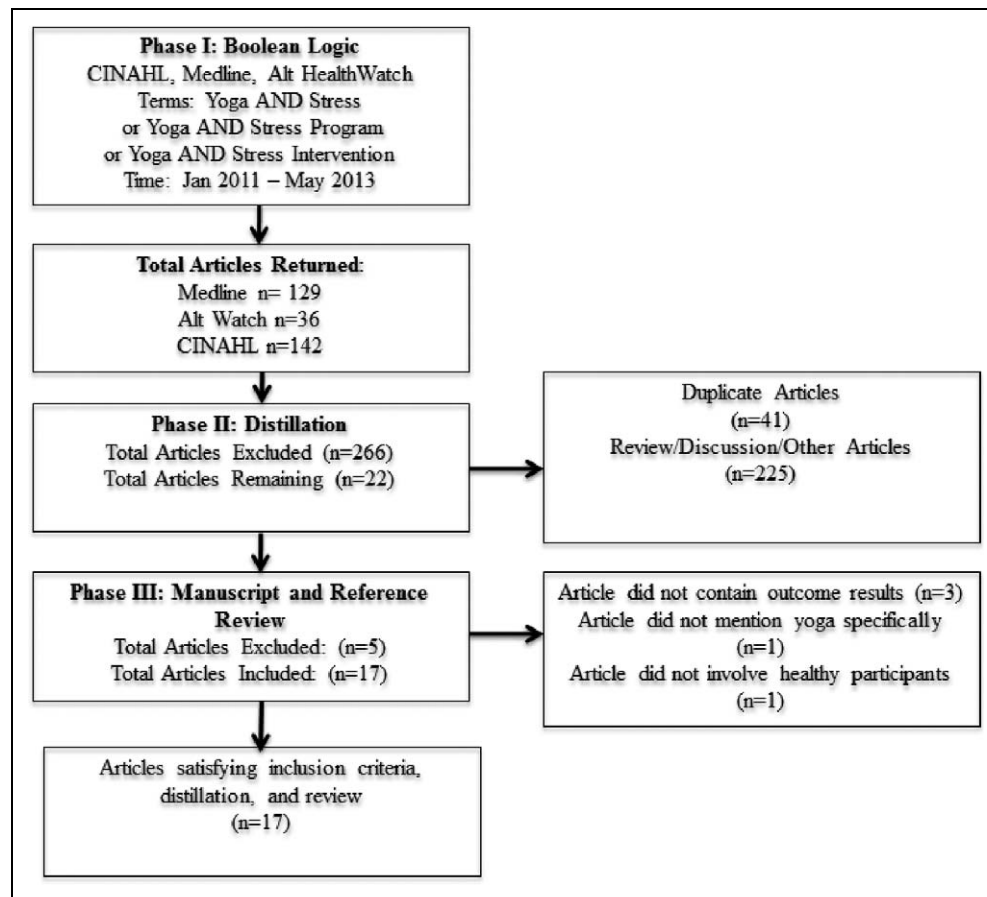


Figure 1. Flow chart depicting the three phase data extraction process.

commonly used to measure perceived stress.³⁴ Besides these, Feel Bad Scale³⁵ for Children and Visual Analogue Scale for perceived stress²² were also used. Psychological outcome measures were used by all studies except for one,²⁸ which only used physiological measures. Physiological measures were measured by 9 interventions and included heart rate,^{18,22,30-33} respiratory rate,^{18,22,30} blood pressure,^{18,22,30,31,33} serum cortisol,¹⁸ salivary cortisol,²⁵ serum interleukin,¹⁸ serum interferon,¹⁸ physical fitness,²⁰ blood lipids,²⁸ hematological parameters,²⁸ thoracic excursions,³³ and peripheral oxygen saturation.³³

Discussion

The aim of this review was to look at studies published from 2011 to May 2013 and examine whether yoga can be an alternative and complementary therapeutic approach for managing stress. A total of 17 studies met the inclusion criteria. The first question that this review addressed was: “Has yoga been found to be efficacious in alleviating stress in otherwise healthy individuals since the 2011 review?” From the 17 studies, a majority (n = 12)^{17,19-23,25-27,30,32,33} demonstrated positive changes in psychological or physiological outcome measures related to stress. Only 2 studies^{29,31} showed no change in stress-related outcome measures, while 3 studies had mixed results.^{18,24,28} These findings are in consonance with the

previous review published in 2011, which found that 7 out of 8 studies had positive results.¹⁶ Of the 12 studies that have shown positive results, only 8 have used randomized controlled designs.^{19,21,23,26,27,30,32,33} This type of design is considered the most rigorous as it enlists pretests and posttests, randomizes the participants or their group into a control group and an experimental group, and minimizes threats to internal and external validity. In this design, changes in pretest and posttest scores can be contrasted by levels of intervention. This can be seen in the randomized control trial from Germany,²³ which had 3 groups: (a) yoga group that received 12 sessions over 3 months, (b) yoga group that received 24 sessions over 3 months, and (c) control group. The findings showed significant decrease in both the yoga groups at 3 months when compared to control group for perceived stress ($P = .003$), state anxiety ($P = .021$), and trait anxiety ($P = .003$) and significant improvement in scores for depression ($P = .008$), quality of life ($P = .012$), and mood states ($P = .007$).

On the other hand is the pretest–posttest design. Pretest–posttest design is the least costly and simplest, but is unable to minimize threats to internal validity such as maturation and history without a control group for comparison. In this review, 1 study used this design and was able to demonstrate positive changes in stress-related outcomes. This was the study from United States using Bikram yoga,²⁰ which demonstrated from

pretest to posttest improvement in mindfulness, perceived stress, cardiorespiratory endurance, flexibility, and balance ($P < .01$). But without having a control group the findings can only be interpreted with caution. With regard to design, future studies should use the robust randomized control design, or if that is not feasible, as in school settings, the group randomized control design must be used.

The second and third questions this review examined were the following: “Is there sufficient data available to draw conclusions regarding the efficacy of yoga 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 10 were randomized controlled designs. Based on these studies, some conclusions can be made but one would need to consider the limitations. Besides the design, some other shortcomings that need to be kept in mind while interpreting the efficacy of yoga in stress management are the small sample sizes used in the studies, the lack of standardization of the yoga interventions, and varying dosages of the interventions. The sample sizes have generally been small with only 2 studies having sample size more than 100. Power calculations and sample size justifications are generally missing from most of the reviewed studies. There have been no multicentric studies or large-scale studies that have been done with this research problem. Future research should look at the possibility of conducting large-scale studies. The yoga interventions have been from a variety of schools of yoga and substantial numbers do not even identify any particular school. It is essential to identify at least a few asanas, a few breathing techniques, relaxation pose (shava asana), and meditation that are common to all yoga interventions. While most interventions did mention use of these techniques, it will be important for the field to develop a checklist of essential ingredients that can be replicated. There has been a wide variability of intervention dosage that has ranged from 30 minutes to 6 months. The 30-minute intervention from Australia²² has successfully demonstrated that yoga and meditation were able to reduce perceived stress in a short duration of time. However, long-term sustenance of effect is questionable in this short approach. Duration of yoga was not found to be linked with efficacy in this review. But most of the interventions have ranged from 6 to 12 weeks ($n = 10$) and that seems to be ideal both for feasibility as well as practicality. Future research should aim at developing interventions that are in the range of 6 to 12 weeks.

The final question that this review attempted to answer was the following: “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 except for 1 study. The most common outcome measure was the score on a perceived stress scale, which was used by 10 studies. There were 3 ways by which perceived stress was measured: (a) Cohen’s Perceived Stress Scale,³⁴ (b) Feel Bad Scale³⁵ for children, and (c) Visual Analogue Scale for perceived stress.²² Cohen’s Perceived

Stress Scale is in the public domain and is certainly a useful measure to use in studies examining yoga and stress. If the target population is children, then the Feel Bad Scale can be used. The common physiological measures that can be used in future studies are heart rate (and its variability), blood pressure, respiratory rate, and, if possible, salivary cortisol.

Conclusions

Stress is a major public health problem and one of the approaches to address this problem is through yoga. A total of 17 interventions from 2001 to May 2013 looked at yoga and its efficacy in alleviating stress. Of these only 12 interventions were able to find positive effects in psychological or physiological outcome measures related to stress. Despite the limitations of not all studies using a randomized controlled design, having smaller sample sizes, having different outcome measures, having nonstandardized yoga intervention, and having varying lengths of intervention, yoga is a promising modality for stress management. All practitioners teaching stress management should teach yoga as one of the approaches to stress reduction.

Declaration of Conflicting Interests

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

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

Ethical Approval

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

References

1. Milczarek M, Schneider E, Gonzalez E; European Agency for Safety and Health at Work. *OSH in Figures: Stress at Work—Facts and Figures*. Luxembourg: European Communities; 2009.
2. Romas JA, Sharma M. *Practical Stress Management. A Comprehensive Workbook*. 6th ed. San Francisco, CA: Pearson; 2014.
3. Sharma M, Atri A, Branscum P. *Foundations of Mental Health Promotion*. Sudbury, MA: Jones & Bartlett; 2013.
4. Selye H. *Stress Without Distress*. Philadelphia, PA: Lippincott; 1974.
5. Holmes TH, Rahe RH. The Social Readjustment Rating Scale. *J Psychosom Res*. 1967;11:213-218.
6. Lazarus RS, Folkman S. *Stress, Appraisal, and Coping*. New York, NY: McGraw-Hill; 1984.
7. Sharma M, Romas JA. *Theoretical Foundations of Health Education and Health Promotion*. 2nd ed. Sudbury, MA: Jones & Bartlett; 2012.
8. Steinmetz J, Blakenship J, Brown L, Hall D, Miller G. *Managing Stress Before It Manages You*. Palo Alto, CA: Bull; 1980.
9. Berne E. *Transactional Analysis*. New York, NY: Harper College; 1967.

10. Ellis A, Grieger R. *RET Handbook of Rational Emotive Therapy*. New York, NY: Springer; 1977.
11. Perls FS. *Gestalt Therapy Verbatim*. Moab, UT: Real People Press; 1969.
12. Wolpe J. *The Practice of Behavior Therapy*. 2nd ed. New York, NY: Pergamon; 1973.
13. Singh K. *Religions of India*. New Delhi, India: Clarion Books; 1983:76-78.
14. Maharishi YV. *Journey of Consciousness*. New Delhi, India: Macmillan India; 1992:2-50.
15. Maharishi YV. *Logical Solutions for the Problems of Humanity*. Erode, India: Vethathiri Publications; 1998:4.
16. Chong CS, Tsunaka M, Tsang HW, Chan EP, Cheung WM. Effects of yoga on stress management in healthy adults: a systematic review. *Altern Ther Health Med*. 2011;17(1):32-38.
17. Brisbon NM, Lowery GA. Mindfulness and levels of stress: a comparison of beginner and advanced Hatha yoga practitioners. *J Relig Health*. 2011;50:931-941. doi:10.1007/s10943-009-9305-3.
18. Gopal A, Mondal S, Gandhi A, Arora S, Bhattacharjee J. Effect of integrated yoga practices on immune responses in examination stress—a preliminary study. *Int J Yoga*. 2011;4:26-32. doi:10.4103/0973-6131.78178.
19. Hartfiel N, Havenhand J, Khalsa SB, Clarke G, Krayner A. The effectiveness of yoga for the improvement of well-being and resilience to stress in the workplace. *Scand J Work Environ Health*. 2011;37(1):70-76.
20. Hewett ZL, Ransdell LB, Yong G, et al. An examination of the effectiveness of an 8-week Bikram yoga program on mindfulness, perceived stress, and physical fitness. *J Exerc Sci Fitness*. 2011;9(2):87-92.
21. Hartfiel N, Burton C, Rycroft-Malone J, et al. Yoga for reducing perceived stress and back pain at work. *Occup Med (Lond)*. 2012;62:606-612. doi:10.1093/occmed/kqs168.
22. Melville GW, Chang D, Colagiuri B, Marshall PW, Cheema BS. Fifteen minutes of chair-based yoga postures or guided meditation performed in the office can elicit a relaxation response. *Evid Based Complement Alternat Med*. 2012;2012:501986. doi:10.1155/2012/501986.
23. Michalsen A, Jeitler M, Brunnhuber S, et al. Iyengar yoga for distressed women: a 3-armed randomized controlled trial. *Evid Based Complement Alternat Med*. 2012;2012:408727. doi:10.1155/2012/408727.
24. Noggle JJ, Steiner NJ, Minami T, Khalsa SB. Benefits of yoga for psychosocial well-being in a US high school curriculum: a preliminary randomized controlled trial. *J Dev Behav Pediatr*. 2012;33:193-201. doi:10.1097/DBP.0b013e31824afdc4.
25. Rocha KK, Ribeiro AM, Rocha KC, et al. Improvement in physiological and psychological parameters after 6 months of yoga practice. *Conscious Cogn*. 2012;21:843-850. doi:10.1016/j.concog.2012.01.014.
26. Shankarapillai R, Nair MA, George R. The effect of yoga in stress reduction for dental students performing their first periodontal surgery: a randomized controlled study. *Int J Yoga*. 2012;5:48-51. doi:10.4103/0973-6131.91714.
27. Stoller CC, Greuel JH, Cimini LS, Fowler MS, Koomar JA. Effects of sensory-enhanced yoga on symptoms of combat stress in deployed military personnel. *Am J Occup Ther*. 2012;66:59-68.
28. Subramanian S, Elango T, Malligarjunan H, Kochupillai V, Dayalan H. Role of sudarshan kriya and pranayam on lipid profile and blood cell parameters during exam stress: a randomized controlled trial. *Int J Yoga*. 2012;5(1):21-27. doi:10.4103/0973-6131.91702.
29. White LS. Reducing stress in school-age girls through mindful yoga. *J Pediatr Health Care*. 2012;26(1):45-56. doi:10.1016/j.pedhc.2011.01.002.
30. Wolever RQ, Bobinet KJ, McCabe K, et al. Effective and viable mind-body stress reduction in the workplace: a randomized controlled trial. *J Occup Health Psychol*. 2012;17:246-258. doi:10.1037/a0027278.
31. Hagins M, Haden SC, Daly LA. A randomized controlled trial on the effects of yoga on stress reactivity in 6th grade students. *Evid Based Complement Alternat Med*. 2013;2013:607134. doi:10.1155/2013/607134.
32. Huang FJ, Chien DK, Chung UL. Effects of Hatha yoga on stress in middle-aged women. *J Nurs Res*. 2013;21:59-66. doi:10.1097/jnr.0b013e3182829d6d.
33. Köhn M, Persson Lundholm U, Bryngelsson IL, Anderzén-Carlsson A, Westerdahl E. Medical yoga for patients with stress-related symptoms and diagnoses in primary health care: a randomized controlled trial. *Evid Based Complement Alternat Med*. 2013;2013:215348. doi:10.1155/2013/215348.
34. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav*. 1983;24:385-396. doi:10.2307/2136404.
35. Lewis C, Siegel J, Lewis M. Feeling bad: exploring sources of distress among pre-adolescent children. *Am J Public Health*. 1984;74:117-122.