

Yoga as an Alternative and Complementary Treatment for Hypertensive Patients: A Systematic Review

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Abstract

Hypertension is a worldwide public health concern. It is a risk factor for heart disease and stroke. Pharmacological therapy is the most popular method to control hypertension, but yoga has been identified as a promising alternative and complementary therapy to costly drugs. A systematic review is presented below to determine the efficacy of yoga. The criteria for study to be included were as follows: (a) published in the English language, (b) between January 1972 and March 2012, (c) included any form of yoga as an intervention (with or without pharmacological therapy), (d) used any quantitative study design, and (e) measured blood pressure as an outcome. A total of 19 studies met these criteria. Of the 19 studies systematically analyzed, 12 demonstrated a significant change in blood pressure using yoga as part of the intervention. Limitations include a lack of theory-based approach, self-reporting errors, and few randomized controlled trials.

Keywords

yoga, hypertension, blood pressure, *pranayama*, prehypertension, meditation, breathing, postures

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An estimated 65 million Americans have hypertension, according to the National Health and Nutrition Examination Survey.¹ Worldwide, 1 billion people are hypertensive.² Hypertension is a risk factor for coronary artery disease and cerebrovascular disease.³ Although there are many predisposing factors that can cause hypertension, including stress, genetic predisposition, and overweight, uncontrolled blood pressure continues to be a public health concern worldwide. Pharmacological therapy is the most popular method to control hypertension, but barriers influencing the efficacy of this type of therapy include difficulty with dosage adherence and, for those with uncontrolled hypertension, an increased amount of the drug is necessary over time.⁴ Furthermore, the high cost of such drugs, as well as the negative side effects, and simply that many patients reject this type of therapy has led health professionals to explore other options.⁵

Yoga is a promising alternative to the costly pharmacological therapy. In India, yoga has been used for its therapeutic benefits for centuries and is currently being explored in the West because of its increase in popularity with more than 14 million users.⁶ Yoga is a discipline that integrates the mind and body for spiritual goals encompassing low physical impact postures (*asanas*), breathing techniques (*pranayama*), meditation (*dhyana*), and lifestyle modifications.⁷ Yoga has shown to be promising when used as a stress management tool.³ The purpose of this review is to identify and describe studies measuring yoga's effectiveness, as an alternative or in tandem with pharmacological therapy, to improve blood pressure in

prehypertensive (systolic pressure of 120-139 mm Hg or a diastolic pressure of between 80 and 89 mm Hg) and hypertensive (defined as systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mm Hg) patients.

Questions being addressed in this study include the following: Is yoga efficacious alone, or in tandem with medication, to significantly reduce blood pressure among prehypertensives and hypertensives and are there sufficient data available to draw conclusions regarding the efficacy of yoga in lowering hypertension? What type of bias exists in this field of study (sampling bias, publication bias, bias within studies, and bias across studies)?

Methods

A systematic review of studies regarding yoga and hypertension interventions was the method used in this study. The criteria for inclusion were that the study must (a) be published in the English language, (b) be between January 1972 and

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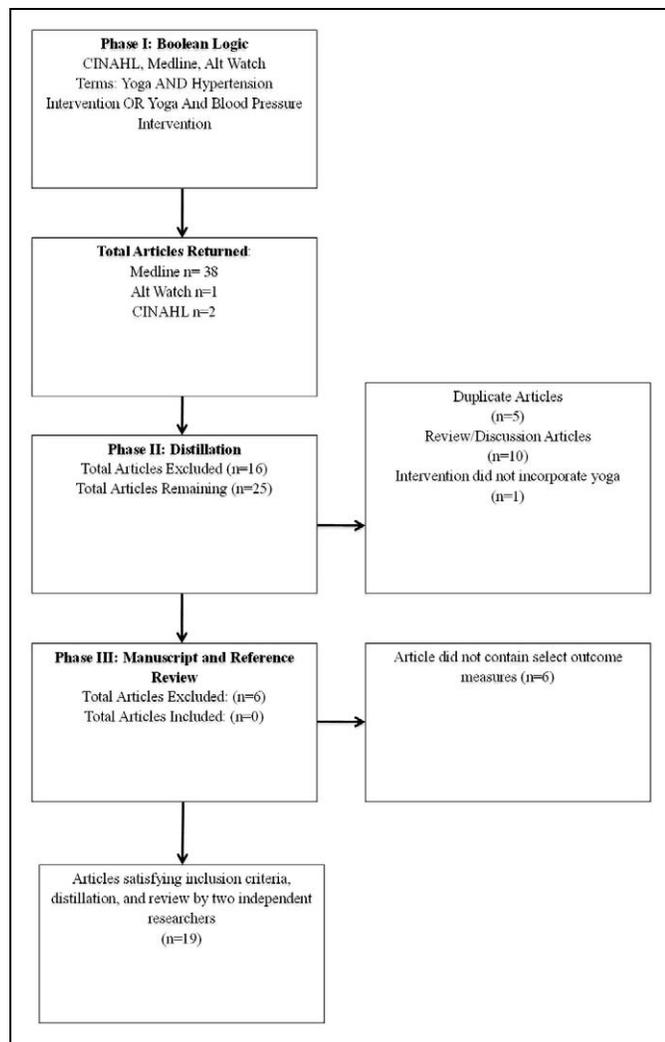


Figure 1. Flowchart depicting the 3-phase data extraction process

March 2012 (past 40 years), (c) include any form of yoga as an intervention (with or without pharmacological therapy), (d) use any quantitative study design, and (d) measure blood pressure as an outcome. Exclusion criteria were studies that (a) did not implement a quantitative design, (b) did not sample hypertensive or prehypertensive patients, and (c) did not index in any of the following databases, CINAHL (Cumulative Index to Nursing and Allied Health), Medline, or Alt HealthWatch. Considering there are few studies regarding yoga and hypertension, it was imperative that the published data criteria be as open as possible and span a long time period. In addition, yoga has been used as a therapy for many ailments, including anxiety, diabetes, and depression. Here, it was necessary to omit these studies by including phrases regarding blood pressure or hypertension.

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 Hypertension Intervention”

and “Yoga AND Blood Pressure Intervention.” Using the above terms/phrases 41 articles were returned in all: from Medline (n = 38), Alt HealthWatch (n = 1), and CINAHL (n = 2). Phase II included preliminary distillation of the articles by eliminating duplicates (n = 5), review/discussion articles (n = 10), and studies not incorporating yoga in the intervention (n = 1). Of the remaining articles (n = 25), 6 did not incorporate blood pressure measurements in the outcome measures. The remaining articles (n = 19) satisfied the eligibility criteria (Figure 1).

Results

The complete data extraction process resulted in 19 articles satisfying the eligibility criteria. Table 1 summarizes the studies, including the year of publication, authors, study design and sample size, age of participants, intervention modality and dosage, and the salient findings. The studies are arranged by year of publication in chronological order.

Discussion

The purpose of this systematic review was to determine the efficacy of yoga, with or without pharmacological therapy, in reducing blood pressure among prehypertensive and hypertensive patients by analyzing studies published between January 1972 and March 2012. Few studies implementing yoga as part of an intervention to reduce blood pressure were found (n = 19). Of the 19 studies analyzed, 11 were conducted in India, 4 were conducted in the United States, 2 were conducted in the United Kingdom, and 1 was conducted in Thailand. Although yoga originated in India, its use of mild movements and gentle physical activity allow it to be easily adapted in all parts of the world. Considering, the first step of management against hypertension—especially among prehypertensives and stage I hypertensives—is lifestyle modification, there is urgent need to determine the efficacy of yoga to reduce blood pressure among these at-risk groups.¹⁷

Of the 19 studies systematically analyzed here, 13 demonstrated a significant change in blood pressure using yoga as part of the intervention.* In these studies, prehypertension was defined as a systolic pressure of 120 to 139 mm Hg or a diastolic pressure of 80 to 89 mm Hg and hypertension was defined as systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mm Hg. Although 7 of the studies did not demonstrate a statistically significant decrease of blood pressure, reductions were found among all studies.

Among the studies included in this review, 6 implemented a randomized control design,^{2,4,15,17,19,22} whereas 7 used a quasi-experimental approach,^{3,8,10-12,14,18} 5 used a pretest–posttest design,^{5,9,16,20,21} and 1 was a case study.¹³ Studies using randomized control design are considered the most robust as the threats to external and internal validity are at a minimum: It institutes a pre- and posttest, uses a control group for

*References 1-4, 8, 10, 11, 14, 15, 17, 18, 20, 22.

Table 1. Summary of Interventions Exploring Role of Yoga in Hypertension (n = 19)

Year	Author(s)	Design and Sample	Age (Years)	Intervention Modality	Intervention Dosage	Salient Findings
1973	Patel ⁵	Pretest–posttest design; n = 20 subjects with hypertension	39-78	Yoga and biofeedback	Patients attended, individually, a relaxation and breathing program 3 times/wk for 30 min for 3 mo	Mean systolic blood pressure (SBP) reduction from 160 to 134 mm Hg and mean diastolic blood pressure (DBP) reduction from 102 to 86 mm Hg
1975	Patel ⁸	Quasi-experimental design; n = 40 of whom 20 were hypertensive patients and 20 were age- and sex-matched hypertensive controls	39-78	Yoga and biofeedback	9- and 12-month follow-up of the Patel 1973 study ⁵ ; 3 mo of relaxation technique 3 times/wk for 30 min	In experimental group, the mean SBP was reduced by 20.4 ± 11.4 mm Hg, DBP reduced by 14.2 ± 7.5 mm Hg (P < .001)
1976	Blackwell et al ⁹	Pretest–posttest design; n = 7 individuals with DBP >95 mm Hg who responded to advertisement	39-59	Transcendental meditation (TM)	4-d 2-h instruction of TM then practicing at home for 20 min 2 times a day for 3 mo	At 3 mo, mean change in SBP was 4.16 mm Hg and in DBP was 1.61 mm Hg. At 6 mo, mean change in SBP was 2.56 mm Hg and in DBP was 4.03 mm Hg
1979	Lakshmikanthan et al ¹⁰	Quasi-experimental design; n = 44 subjects divided into 3 groups (hypertension, hypertension with coronary artery disease [CAD], and CAHD alone) recruited from a yogic health center	40-60	Asana yoga course	Asanas were performed for 30 d weekly for 20-30 min	For group I, the hypertension group, SBP was reduced from 154.6 ± 11.83 to 144.86 ± 26.81 mm Hg (P < .05); DBP was reduced from 99.4 ± 11.90 to 90.6 ± 11.03 mm Hg (P < .01)
1983	Sundar et al ¹¹	Quasi-experimental design; n = 25 subjects with essential hypertension divided into 2 groups	33-47	Shavasana	Shavasana was performed twice daily for 6 mo	Patients receiving shavasana alone reduced SBP from 153.3 ± 2.99 to 139.3 ± 3.12 mm Hg and DBP from 102.7 ± 2.38 to 90.4 ± 2.03 mm Hg (P < .001)
1988	Chaudhary et al ¹²	Quasi-experimental design; n = 50 hypertensives and n = 10 controls; group I receiving shavasana for 4 wk (n = 20); group II (n = 10) for 2 wk; group II-A shavasana, group II-B antihypertensives (anti-HTs); group II-C combined; group III (n = 20) with anti-HTs and shavasana for 4 wk		Shavasana (relaxation technique, including closed eyes, rhythmic breathing, and relaxed muscles)	Control shavasana for 4 wk, group I shavasana for 4 wk, group II shavasana and/or anti-HTs for 2 wk, group III shavasana and anti-HTs for 4 wk. All Shavasana performed 30 min daily	Group II-A reduction in SBP = 23.5% and DBP = 22%. Group III reduction in SBP = 25.18% and DBP = 25.16%
1989	Brownstein and Dembert ¹³	Case study; n = 1 US Air Force aviator with mild essential hypertension taking anti-HT medication	46	Yoga relaxation (postures, breathing, and relaxation)	6 wk with once a week check-ups to check yoga practice	BP change from 138/92 mm Hg after 6 wk was 122/86 mm Hg without medication, at 6-mo follow-up. BP was 122/86 mm Hg

(continued)

Table 1. (continued)

Year	Author(s)	Design and Sample	Age (Years)	Intervention Modality	Intervention Dosage	Salient Findings
1997	Selvamurthy et al ¹⁴	Quasi-experimental design; n = 20 hypertensive males slowly withdrawn from anti-HT medication, divided into 2 groups age-wise	32-53	Yogic asanas or postural tilt stimulus	3-wk course of yogic postures equivalent to head-up/down tilt daily	BP significantly declined ($P < .001$) by day 5 of yoga. SBP decreased from 171 ± 6.1 to 142 ± 2.5 mm Hg and DBP from 112 ± 4.0 to 95 ± 2.6 mm Hg ($P < .000$)
1999	Murugesan et al ¹⁵	Random control design; n = 33 hypertensives randomized into 3 groups	35-65	Yoga, including <i>shavasana</i> , <i>vakrasana</i> , <i>vajrasana</i> yoga, <i>chakrasana</i> , <i>tadasana</i> , and meditation	For 11 wk the experimental group practiced yoga for 1 h twice daily 6 d/wk	For yoga group, SBP was reduced from 156.45 ± 9.32 to 123.09 ± 10.14 mm Hg and DBP from 108.63 ± 9.92 to 82.36 ± 9.14 mm Hg ($P < .01$)
2002	Damodaran et al ¹⁶	Pretest-posttest design; n = 20 patients with mild to moderate hypertension	35-55	Yogic practices, including <i>asanas</i> , <i>mudras</i> , and <i>pranayama</i>	Performed yoga 1 h daily for 3 mo	Significant fall in SBP (148.6 ± 5.2 to 126.4 ± 4.4 mm Hg) and DBP (104.2 ± 3.5 to 86.8 ± 2.6 mm Hg)
2005	McCaffrey et al ³	Quasi-experimental; n = 54 subjects with BP > 149/90 mm Hg not currently on anti-HT medication		Yoga <i>pranayama</i> and yoga <i>asana</i>	Yoga practice 3 times a week for 63 min for 8 wk	In yoga group, SBP decreased from 160.89 to 136.04 mm Hg and DBP decreased from 85.59 to 73.64 mm Hg on average from week 0 to 8 ($P < .01$)
2009	Cohen et al ¹⁷	Random control design; n = 78 yoga naive adults who are prehypertensive or stage I hypertensive	22-69	Iyengar Yoga (IY)	Experimental: 70 min IY 2/wk for 6 wk then 70 min IY 1/wk for next 6 wk	In yoga group, SBP decreased from 132 to 125 mm Hg ($P < .05$) and DBP decreased from 83 to 78 mm Hg by week 12 ($P < .01$)
2009	Mourya et al ⁴	Random control design, 3 groups; control, fast breathing, and slow breathing; n = 60 of patients with SBP 140-159 mm Hg and DBP 90-99 mm Hg receiving outpatient care		Yoga <i>pranayama</i> (slow- and fast-breathing groups)	Practice breathing 15 min 2 times per day for 3 mo	In fast-breathing group, significant reduction in SBP and DBP ($P = .004$ and $P = .003$, respectively). In slow-breathing group, significant reduction in SBP and DBP ($P = .000$, $P = .000$, respectively)
2009	Saptharishi et al ²	Random control design; n = 113 prehypertensive or hypertensive subjects from previous studies randomized into 1 control group and 3 experimental groups	20-25	Yoga, <i>pranayama</i> and <i>asanas</i>	8-wk yoga program for 30-45 min/d at least 5 d/wk	In yoga group, reduction in SBP/DBP of $2.0/2.6$ mm Hg ($P < .05$)

(continued)

Table 1. (continued)

Year	Author(s)	Design and Sample	Age (Years)	Intervention Modality	Intervention Dosage	Salient Findings
2010	Agte et al ¹⁸	Quasi-experimental design; nonrandom sampling of control group and hypertensive group n = 52	45-60	Sudarshan Kriya yoga (rhythmic breathing exercises)	2-mo practice of Sudarshan Kriya yoga	For hypertensive women, SBP changed from 126.1 ± 11.6 to 127.0 ± 14.1 mm Hg (nonsignificant) and DBP changed from 85.2 ± 9.7 to 81.7 ± 5.8 mm Hg (P < .01). For hypertensive men, SBP changed from 132.2 ± 12.4 to 130 ± 12.4 mm Hg (nonsignificant) and DBP changed from 88.2 ± 7.8 to 83.4 ± 6.6 mm Hg (P < .01) Yoga group reduced SBP (-5 ± 2 mm Hg) and DBP (-3 ± 1 mm Hg), no change observed in standard of care group
2010	Cade et al ¹⁹	Random control design; HIV-infected adults with mild to moderate cardiovascular disease randomized into control/standard of care (n = 26) and yoga group (n = 34)	18-70	Individual and group instruction in <i>ashtanga vinyasa</i> (coordination of breath with movement)	Experimental: 20 wk of 2-3/wk for 60-min yoga sessions	Yoga group reduced SBP (-5 ± 2 mm Hg) and DBP (-3 ± 1 mm Hg), no change observed in standard of care group
2010	Murthy et al ²⁰	Pretest-posttest design; n = 104 patients with mild to moderate hypertensive on anti-HT medication		Naturopathy and yoga	21-d inpatient program of 30 min/d yoga	Mean reduction in SBP by 10 mm Hg and DBP by 5.1 mm Hg. Of the 53 subjects withdrawn from anti-HT, SBP was reduced from 140.4 ± 13.66 to 124.37 ± 11.42 mm Hg and DBP reduced from 93.2 ± 9.9 to 82.9 ± 6.9 mm Hg (P < .001)
2011	Bhavanani et al ²¹	Pretest-posttest design; n = 23 subjects with essential hypertension for >5 years on at least one anti-HT medication	45-70	<i>Sukha pranayama</i> (yoga breathing)	Practice 6 breaths/min for 5 min, one time only	Immediate results of SPB fell from 136.13 ± 3.32 to 126.96 ± 2.54 mm Hg (P < .001), DBP fell from 77.83 ± 1.48 to 75.74 ± 1.32 (nonsignificant)
2011	Subramanian et al ²²	Crossover randomized control design of an earlier randomized controlled trial; n = 98 divided into 4 groups	21-25	Yoga	Yoga was practiced for 30-45 min/d, 5 d/wk for 8 wk	In yoga group, reduction of SBP by 2.3 ± 1.2 mm Hg and reduction of DBP by 2.4 ± 1.6 mm Hg (P < .05)

comparison, and subjects are randomly selected for each group. Quasi-experimental design is similar to a random control design, except that it does not include randomizing the sample, meaning subjects are specifically selected for each group. This sometimes occurs when the researchers' intent is to match subjects between groups or when random selection is not ethical.²³ Pretest–posttest design, although the simplest, and less costly than a randomized control trial, contains threats to the internal validity of the study, including history (external events between the pre- and posttest) and maturation (growth of the subjects).

Of the identified studies, 5 implemented *pranayama* (slow and fast breathing techniques), 4 implemented *asanas* (low-impact physical activity exercises), 1 implemented yoga with the use of transcendental meditation, 1 used yoga with naturopathy, 1 used Iyengar yoga, 1 used *Sudarshan Kriya* yoga (rhythmic breathing exercises), 3 included *shavasana* (relaxation technique, including closed eyes, rhythmic breathing, and relaxed muscles), 1 implemented *Ashtanga Vinyasa* (coordination of breath with movement), and 3 studies used unspecified yoga techniques. *Shavasana*, a relaxation technique, can include withdrawing thoughts from the external environment, supine muscle relaxation, closed eyes, and concentration on breathing patterns.¹² *Asanas* have been described as more than just stretching as they include meditation in prolonged postures that focus the mind and purify the body. In *pranayama* yoga, the intent is to eliminate physical and emotional stress through deep breathing known to reduce sympathetic activity, therefore, reducing blood pressure.³ It seems that a combination of methods such as *asanas*, *pranayama*, and *shavasana* seems to be more efficacious and must be used by future interventions.

The duration of identified studies in this review range from a one-time yoga breathing technique to obtain immediate blood pressure changes²¹ to a 6-month intervention.¹⁴ Among the studies the durations of the interventions were 6 months ($n = 1$), 5 months ($n = 1$), 3 months ($n = 5$), 11 weeks ($n = 1$), 2 months ($n = 4$), 6 weeks ($n = 2$), 1 month ($n = 1$), 3 weeks ($n = 2$), 2 weeks ($n = 1$), and a one-time practice ($n = 1$). To correctly gauge the efficacy of a yoga intervention on reducing blood pressure it can be recommended that the intervention must be at least 2 to 3 months long with regular and sustained practice of yoga.

Of the most robust studies reviewed here, the randomized controlled trials, some comparison groups and their outcomes are worth noting, including antihypertensive drugs versus yoga¹⁵ and control versus physical activity versus salt intake reduction versus yoga.^{2,22} For the randomized controlled trial comparing antihypertensive drug usage and yoga, the data demonstrated that yoga was more effective in reducing systolic blood pressure ($P < .05$) compared with the drug therapy group. When comparing all 4 groups of control, physical activity, salt intake reduction, and yoga in both studies,^{2,22} salt-intake reduction was comparable to the yoga intervention ($P > .05$), whereas physical activity was reported as the most effective for reducing hypertension. It is important to note that in the randomized controlled trial comparing 4 groups were among young adults with hypertension and prehypertension and that moderate physical activity may not be suitable for older adult

populations. This would allow yoga to act as an effective alternative as it uses low-impact exercises and relaxation techniques.

The majority of the interventions included practicing the yoga technique numerous times, independently: 2 to 3 times weekly ($n = 5$), once weekly ($n = 3$), twice daily ($n = 4$), and once daily ($n = 3$). This means that the majority of the studies included self-reporting, making it difficult to determine if subjects followed the routine as directed. In addition, it would be impossible to determine if they were practicing correctly without affecting the cost, time, and attrition rates of the studies. Of the studies identified, an additional disadvantage was the lack of use of a theoretical model in the planning of the intervention. Future interventions can use behavioral theories such as social cognitive theory, health belief model, theory of reasoned action, theory of planned behavior, or transtheoretical model in designing yoga interventions, which would be more efficacious.²⁴

Although some disadvantages associated with yoga interventions have been identified, it is important to consider the advantages of using yoga for hypertension; it is less costly than pharmacological therapies, can be a safer alternative to drugs, and can bring about alterations to the autonomic nervous system's response to stress.⁴ It is estimated that 1.56 billion people will be diagnosed with hypertension by 2025, and given this projection, it is important that a widely appealing, cost-effective, and safe method to reduce blood pressure be identified.²

Author Contributions

MS conceptualized the study, developed the inclusion criteria, collected the data, developed the table, analyzed the data, and reviewed the manuscript. TH collected the data, analyzed the data, and wrote the first draft of the manuscript.

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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