The Effect of Yoga Interventions on Hypertension: A Systematic Review

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ABSTRACT

Objective: The focus of this current study is to examine the impact of yoga interventions on hypertension and provide recommendations for future research.

Methods: Four databases were searched for existing studies that observed the impact of yoga on hypertension. Interventions were included if they evaluated yoga relative to a control arm in patients with any form of arterial hypertension. PRISMA guidelines were followed. Two independent reviewers performed the selection of studies, data extraction, and quality assessments.

Results: Nine studies met the inclusion criteria, eight of which were RCTs and one non-RCT. Five studies suggested yoga was effective in reducing systolic blood pressure (SBP) and diastolic blood pressure (DBP), while two studies suggested yoga was effective in reducing SBP. Two studies suggested that yoga did not impact SBP or DBP.

Conclusion: Yoga may be an effective treatment for individuals with hypertension; however, the methodological flaws and inconsistencies of existing studies leaves some questions unanswered. Future studies should include larger samples, yoga interventions that focus on postures, and sessions lasting at least 30 minutes

INTRODUCTION

The World Health Organization (WHO) considers hypertension to be a significant threat to the population's well-being. Hypertension leads to nine million deaths annually, making it one of the most significant risk factors for morbidity and mortality worldwide [1]. The American Heart

Association (AHA) observed that rates of hypertension are increasing due to the aging population and an increased prevalence of risk factors (i.e., high sodium and lack of physical activity;)[2]. The National Health Institute (NIH) noted that untreated hypertension increases the risk of cardiovascular events, dementia, functional muscle decline, and both falls and fractures [3]. Lifestyle interventions targeting hypertension are particularly important, given the low adherence and side effects related to pharmacological treatments [4].

Yoga is one example of a lifestyle intervention that has been used to treat hypertension [5-11]. In the Western world, yoga is considered a holistic approach to health [12]. It consists of mind-body postures and breathing, as well as meditation techniques to stimulate muscular activity and mindful awareness on self, breath, and energy to promote health [13]. By 2021, roughly 34.4 million people in the United States had done yoga, which represented a 64.3% increase since 2010 [14]. Further, by 2015, yoga had become a $9.09 billion industry in the United States [15].

Several studies [5-11] have recently examined yoga's use as a treatment for hypertension. These studies indicate that yoga may be considered as a treatment option for hypertension; however, methodological flaws in previous research [5-11, 16-19] suggest the positive conclusions derived from the studies are not entirely vindicated. Additionally, methodological inconsistencies of selected studies lead to difficulty drawing definitive conclusions. The objective of this review is to examine yoga as a form of treatment for individuals with hypertension, using findings from published studies.

OBJECTIVES

Given yoga's claim of improving blood pressure (BP) among individuals with hypertension, a review of existing studies was conducted to analyze and compare methodology and practice recommendations. The focus of the current study is to examine the impact yoga interventions have on individuals with hypertension and propose an efficacious methodology for yoga practice in future interventions.

METHODS

The Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines were followed for this review.

Figure 1: Study search and selection process

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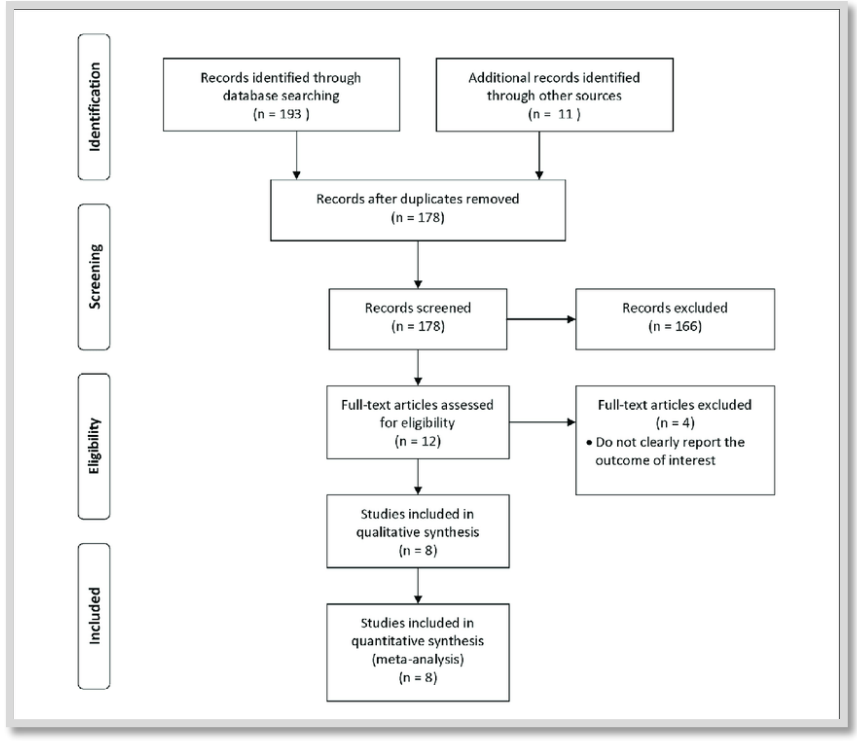

Search Process

The following electronic databases were searched through the University of Minnesota libraries from 2012-present: Academic Search Premier, APA PsycInfo, PubMed, and Sport Discus. The search strategy utilized the terms, "Yoga and (hypertension or high blood pressure)." Additionally, the reference lists of articles were examined to determine eligibility of additional articles. Located articles were read in full.

Inclusion Criteria

The present review included all interventions investigating the effect of yoga on adult patients (≥ 18 of age) diagnosed with hypertension with or without pre-existing comorbidities. Consistent with Collins' (1998) definition, yoga was defined as a practice that consisted of mind-body postures and breathing and meditation techniques to stimulate muscular activity and mindful awareness on self, breath, and energy to promote health. To be eligible for the review, the study had to examine yoga intervening on blood pressure.

Study Selection

Study titles and abstracts were initially screened to select potentially relevant articles. Articles deemed potentially relevant were examined for a full-text evaluation. Articles were reviewed by the first author according to the pre-defined criteria. When uncertainty on a specific article arose, the author sent the article to the second author. Disagreement was resolved through discussion.

Data Extraction

The following information was extracted from the selected studies: Authors and year of publication, study design, number and characteristics of participants, intervention condition, control condition, results between conditions, reported adverse events, author conclusions, and limitations of the interventions. The intervention condition included the program's length, frequency of meetings, total number of sessions, session duration, type(s) of yoga utilized, and setting of sessions. The only outcome measure examined in selected studies was systolic blood pressure (SBP) and diastolic blood pressure (DBP).

RESULTS

A total of 70 articles were screened for potential eligibility. Forty-seven of the 70 studies were removed for not including both yoga as an intervention and BP as an outcome. Of the 23 remaining studies, 15 were removed for including participants without hypertension. Although these studies also included participants with hypertension, they were removed to maintain consistency amongst selected studies. The reference lists for the remaining 8 studies were examined for additional potential articles. One study was found that matched the criteria resulting in 9 studies for

the final review. Eight trials used randomized control trials (RCTs) ranging from two to four arms and one study used a counterbalanced crossover design with two parallel groups.

Table 1: *Interventions of yoga for hypertension*

Study Summaries

Nine studies were identified, eight of which were RCTs and one non-RCT. Blom and colleagues [5] examined the efficacy of a mindfulness-based stress reduction (MBSR) program on lowering BP among unmedicated stage one hypertensive patients in an RCT. The intervention consisted of eight weeks, which involved participants completing 150-minute sessions weekly, one six-hour session/silent retreat, and 45-minutes of homework meditation practice per day. The authors reported no differences between the intervention and the wait-list control condition on either SBP or DBP. No effect size was reported.

Cramer and colleagues [6] compared the BP-lowering effect of yoga interventions with and without yoga postures among patients with arterial hypertension in a RCT. The interventions consisted of a 12-week program which included one, 90-minute in-person meeting at the beginning of each week. Participants were then encouraged to complete sessions every day at home. The authors reported significant reductions in SBP in both the yoga with postures ($p=0.045$) and yoga without postures ($p=0.035$) interventions relative to the control condition but there were no significant differences between conditions on DBP. No effect sizes or clinical significance were reported.

Dhungana and colleagues [7] assessed the effects of a health-worker led yoga intervention on blood pressure reduction among hypertensive patients in the primary care setting in a RCT. The intervention began with daily, structured yoga training in-person sessions lasting two-hours each

for five days. This was followed by five-day per week, 30-minute home-based yoga sessions (i.e., postures, breathing exercises, and meditation) lasting 90 days. The authors reported significantly lower SBP ($p<0.001$) and DBP ($p<0.01$) in the intervention condition relative to the control condition. No effect size or clinical significance was reported.

Punita and colleagues [16] examined the effect of yoga therapy as a lifestyle intervention on cardiac autonomic functions among patients with essential hypertension in a RCT. The 12-week intervention consisted of 45-minute yoga sessions, three times per week with in-person instruction. Additionally, further instruction was provided to practice yoga at home the remaining days of the week utilizing postures and meditation. The authors reported significantly lower SBP ($p<0.05$) and DBP ($p<0.05$) in the intervention condition relative to the control condition. No effect size or clinical significance was reported.

Roche and Hesse [17] examined the efficacy of an integrative yoga program as adjuvant treatment of essential arterial hypertension in a RCT. The intervention consisted of 90-minute sessions focusing on postures, breathing, relaxation, and meditation at a public health center for two days per week for two months. The authors reported significantly lower SBP ($p=0.028$) and DBP ($p=0.001$) in the intervention condition relative to the control condition. No effect size or clinical significance was reported.

Roche and colleagues [8] analyzed the differential effectiveness of three yoga interventions lasting two months specifically designed for essential arterial hypertension treatment in a RCT. The yoga practice program (YPP) intervention consisted of postures, breathing, and meditation for 75 minutes two days per week. The Pranayama intervention consisted of breathing for 40 minutes two days per week. The Himalayan Tradition (HT) intervention consisted of relaxation, meditation, and breathing for 50 minutes two days per week. The authors reported significantly lower SBP ($p=0.035$) relative to the control condition. There were no differences reported for the YPP or Pranayama interventions and the control condition. There were no differences between any conditions for DBP. No effect sizes were reported, however, the clinical significance was found to be higher in all treatment groups relative to the control.

Thanalakshmi and colleagues [9] examined the impact of Sheetali pranayama on resting BP among patients with primary hypertension in a RCT. The intervention consisted of daily, 30-minute sessions for three

months with qualified yoga and naturopathy doctors. The authors reported significantly lower SBP ($p=0.04$) and DBP ($p=0.05$) in the intervention condition relative to the control condition. The effect size was large for SBP ($d=1.04$) and DBP ($d=1.02$), which represented a large clinical significance.

Wang and colleagues [10] assessed the acute effect of mind sound resonance technique (MSRT) on BP, heart rate (HR), and state anxiety in patients with essential hypertension in a counterbalanced crossover study. The intervention condition consisted of participants completing one, 30-minute session of yoga-based relaxation techniques. The authors reported significantly lower SBP ($p<0.001$) and DBP ($P<0.001$) in the intervention condition relative to the control condition. The effect size was moderate for SBP ($d=0.47$) and DBP ($d=0.58$), which represented clinical significance.

Wolff and colleagues [11] evaluated yoga's impact on BP and quality of life on stress, depression, and anxiety among patients with hypertension in a primary care setting in a RCT. The intervention consisted of 15-minute, twice daily, home-based sessions during the 12-week intervention period. The authors reported no differences between the intervention and control condition on either SBP or DBP. No effect size was reported.

Subgroup Analyses

Subgroup analyses revealed that for five interventions investigating patients with hypertension, yoga was effective in reducing SBP and DBP [7, 9, 10, 16, 17]. For two interventions investigating patients with hypertension, yoga was effective in reducing SBP but not DBP [6, 8]. However, Roche and colleagues [8] analyzed three separate yoga programs and found that only one resulted in significant improvement in SBP but no DBP improvement, while the other two arms resulted in no significant differences on either SBP or DBP relative to the control group. Finally, for two studies investigating patients with hypertension, there were no significant differences in either SBP or DBP [5, 11].

RISK OF BIAS

Six studies had an unclear risk of bias, as attempts to reduce bias were not specifically addressed. All studies had a risk of bias regarding participant

randomization blinding. Six studies had a further risk of bias by not including study coordinator blinding. Three studies had an unclear risk of bias by not disclosing the source of funding, meaning there was also an unclear risk of bias in selective outcome reporting.

DISCUSSION

No reviews examining the impact of yoga on hypertension were found in the years 2022-2023. Older reviews suggested that yoga interventions may be effective in reducing BP [18, 19]. However, these reviews included studies with participants without hypertension. The focus of this review was to examine the impact of yoga interventions on hypertension.

Nine total interventions were found. Seven of the interventions favored yoga for reducing SBP [6-10, 16, 17], five of the interventions favored yoga for reducing DBP [7, 9, 10, 16, 17], while two of the interventions revealed no effect on SBP or DBP. No discussion regarding yoga impacting SBP but not DBP existed in any article. The interventions had some notable limitations in regards to methodological rigor and data reporting. These interventions examining the impact of yoga on hypertension suggest yoga can be an effective strategy to treat hypertension; however, definitive judgement should be withheld for a variety of reasons.

The interventions developed across these studies implemented a variety of forms of yoga, which included Sheetali pranayama, MBSR, and general forms of yoga. Specifically, the intervention by Blom and colleagues [5] used MBSR; four interventions used general yoga [6, 7, 16, 17]; the intervention by Roche and colleagues [8] used both YPP and HT meditation; the intervention by Thanalakshmi and colleagues [9] used Sheetali pranayama; the intervention by Wang and colleagues [10] used MSRT; and the intervention by Wolff and colleagues [11] used Kundalini yoga. One distinguishing factor for yoga reducing SBP, yoga sessions included postures and lasted for at least 30 minutes. In addition, one study that found improvement in SBP, as yoga interventions had sessions that included postures as part of the practice and were at least 30 minutes [6-9, 16, 17].

There exists a stereotype in the United States suggesting that yoga is for affluent, educated, White women [20] and therefore, studying yoga in underserved populations is important. Three studies included samples that were well-educated, which supports this assumption [5, 6, 10]. However,

five other studies did not present the education level of their samples at all [8, 9, 11, 16, 17]. Only one study reported information on the race of participants [5]. This study's sample was primarily white individuals, further supporting the assumption of who yoga is meant for. Finally, only one study reported information on the income of participants [7]. Future studies should report demographic data to better understand the samples and there is a need for studies that include diverse samples.

Hypertension rates are higher in individuals who are male, Black, and less educated [21]. Yoga has been observed to be accessible to individuals at-home [22], given the limited space and equipment needed to practice yoga. This can make yoga an effective tool to target hypertension, given that those who experience the highest rates of hypertension are often those who are excluded from yoga practice.

The review revealed mixed results regarding methodological rigor and data reporting in most of the interventions. For example, all studies had a control or comparison condition. However, only one study had an active control group [10]. Further, only five interventions included a large sample size [5-9, 11]. Additionally, three studies did not include or discuss any power analysis for sample size [10, 16, 17]. Only two studies listed effect sizes in their results [9, 10], while only three studies that found a statistically significant difference discussed clinical significance [8-10]. No study mentioned blinding for participant randomization. Further, only three studies included study coordinator blinded randomization in the methods [6, 9, 11]. To continue to address research gaps in yoga and hypertension, future studies should include active controls, specify power analysis for the sample size, and include assessor blinding.

One study did not include any statements regarding conflicts of interest and funding [16]. The remaining studies all included a statement regarding having no conflict of interest. However, of those studies that declared no conflict of interest, two did not disclose their source of funding [9, 17]. This review includes limitations despite attempts to limit bias. First, it is possible that not all relevant articles were located through the search process even though the process was extensive, apart from differences across the database, this might have been due to limited use of keyword and other search parameters. Second, due to the variety of study designs, pooling the data from all studies was deemed impossible. Third, there was a shift in classifying hypertension based on BP [23] in the middle of the time period used for locating studies, which may altered

eligibility criteria for certain studies. Finally, it is possible that publication and location bias may have influenced article discovery, which may have altered conclusions. However, strengths of this review include a systematic literature search, and judicious review of relevant studies.

CONCLUSION

The evidence for yoga as a treatment for individuals with hypertension continues to be encouraging. However, the methodological flaws and inconsistencies of existing studies leave some questions unanswered. Future studies should aim to include larger samples, yoga interventions that focus on postures, and sessions lasting at least 30 minutes.

Notes:

Please refer to annex document Table 1 for Interventions of yoga for hypertension

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