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The Effects of Engaging in Yoga Practice on Reducing Blood Pressure

Benjamin Marples

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Abstract

The purpose of this study was to collect and synthesize evidence from studies examining the relationship between yoga practice and reduction of blood pressure in individuals with hypertension. The PubMed and CINAHL databases were searched using limiters which included humans, English language, peer-reviewed journal articles, full text available, and time restraints from 2010-2020. Eight studies were selected for review. Following yoga intervention, the average decrease in systolic blood pressure among these studies was 4.91 mmHg, a 3.6 percent decrease from the baseline systolic blood pressure measurements conducted before the introduction of yoga. Diastolic blood pressure was also recorded and a decrease of 1.45 mmHg, a change of 1.7% from the baseline diastolic readings was noted. In five of the eight studies included in this review, decreases in both systolic blood pressure and diastolic blood pressure were recorded following yoga. Considering these results, yoga appears to be an effective method of reducing blood pressure among hypertensive patients. Blood pressure control through yoga has implications in reducing patients' needs for antihypertensive medications and the reduction of the practice of polypharmacy in patients.

Hypertension remains an important public health challenge in the United States due to its high prevalence and related morbidity and mortality. Current estimates suggest that as of 2016, 108 million (45%) adults in the United States had hypertension, defined as a systolic blood pressure ≥ 130 mm Hg or a diastolic blood pressure ≥ 80 mm Hg or are taking medication for hypertension (Centers for Disease Control and Prevention, 2019). As the most important modifiable risk factor for cardiovascular disease and all-cause mortality, hypertension was responsible for over 494,873 death in the United States in 2018 (CDC, 2018). The disease burden translates into a substantial economic toll. For example, the estimated annual costs caused by/or related to hypertension were approximately \$131 billion each year, averaged over 12 years from 2003 to 2014 (Kirkland et al., 2018). In particular, the costs of medications, medication interactions, and nonadherence to antihypertensive drugs partly contribute to the current economic toll and high rates of uncontrolled hypertension (Abegaz et al., 2017). This highlights an urgent need to find alternative effective therapeutic strategies to improve blood pressure management among those with hypertension.

Yoga is one such alternative nonpharmaceutical intervention that has shown to improve blood pressure management (Hagins et al., 2013; Okonta, 2012). Though studies exist discussing the relationship of yoga practice to the reduction of blood pressure in patients with hypertension, there are gaps that exist between these studies. One such gap that arises upon review is that while several studies exist investigating the effects of yoga alone on blood pressure, no such review exists to compile the results of studies that measure blood pressure management based on yoga alone. Therefore, evidence from well-designed random controlled trials is warranted to systematically examine the effects of yoga on blood pressure management in the growing population of individuals diagnosed with hypertension.

Methods

This is a systematic review of eight journal articles intended to evaluate the principles of evidence-based practice regarding the foreground PICO question: “In individuals with hypertension, does the participation in yoga reduce blood pressure compared to patients who do not participate in yoga”? The PRISMA system has been used to produce a flowchart to illustrate the different steps in article retrieval and selection for review.

Information Sources

Articles for this review were retrieved using both the PubMed and CINAHL databases using select criteria to filter search results and determine relevance to the topic of review. Both CINAHL and PubMed were searched independently. CINAHL was searched using EBSCOhost and PubMed was searched using the National Center for Biotechnology Information (NCI). A reference search was also conducted based on articles retrieved from both CINAHL and PubMed databases to search for relevant articles not included in either original search.

Search Strategy

For the purpose of searching the PubMed database, two search identifiers were used via the MeSH subject heading search in order to identify relevant articles. The MeSH identifiers used for this literature review include “Hypertension” and “Yoga”. To search the CINAHL database, the same two identifiers (“Hypertension” and “Yoga”) were used to retrieve articles that related to the topic of review. Additionally, a reference search was conducted using articles retrieved from the PubMed and CINAHL databases to identify further relevant articles for review. In the filtering of results additional search limiters were used to further identify relevant articles from both databases. These additional search limiters include humans, English language, peer-reviewed journal articles, full text available, and time restraints from 2010-2020.

Inclusion/Exclusion Criteria

Eligibility for further study was determined using the following elements of the initial PICO question set forth by this review: (1) the study was conducted in individuals with previously diagnosed hypertension (P); (2) the study presented data on the relationship between the participation and yoga and blood pressure measurements (I); (3) the study presented data that was compared to individuals who did not participate in yoga and either participated in another form of therapy, or were part of a control group who received no intervention (C); (4) the study measured participants' blood pressure both before and after participation in yoga (O). Studies were excluded from this review if (a) yoga was not the principle intervention tested in reducing blood pressure in individuals with hypertension, (b) blood pressure were neither measured or mentioned as intended outcome measures of the study, and (c) the study was aimed at reducing risk factors instead of blood pressure in individuals with pre-existing hypertension. It should be noted that the current use of blood pressure regulating medications among participants was not included in the exclusion criteria for the purpose of the review. This is due to the aim of the review to determine the effectiveness of yoga on blood pressure compared to participants who do not participate in the practice of yoga and not meant to determine an alternative form of therapy for hypertension.

Data Extraction

During review of the eight chosen articles, a data extraction sheet was created to identify relevant information that will need to be access for the purpose of completing this review.

Specific information that was extracted from the articles include the names of authors,

publication date, sample size, sample design, demographics of participants, and how the authors of the study measure the outcome specific to the study.

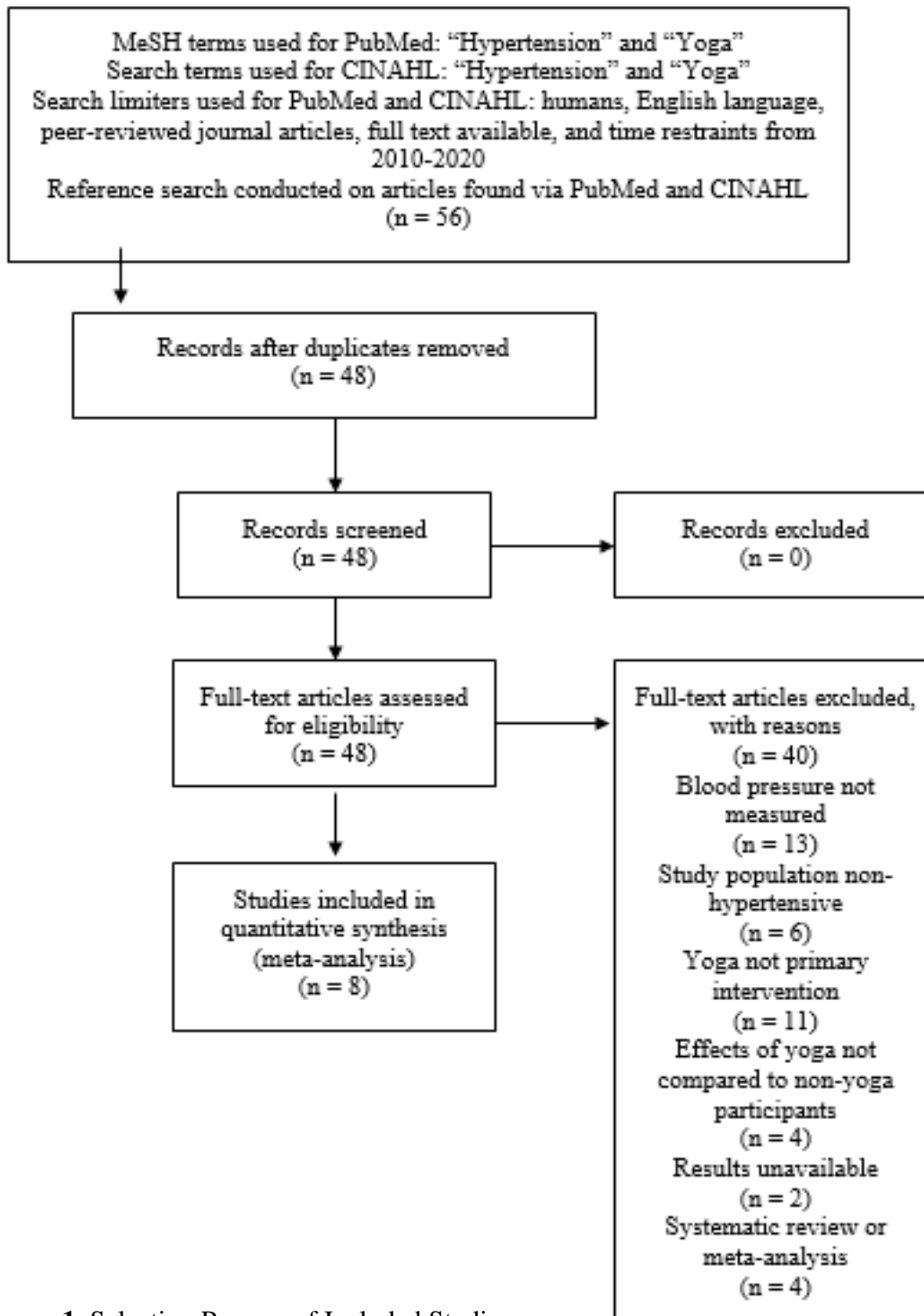


Figure 1. Selection Process of Included Studies

Search Results

The search of PubMed and CINAHL using the beforementioned filters led to the retrieval of 51 studies (14 articles and 37 articles respectively). An additional 5 articles were found during the conduction of the reference search based on previously mentioned studies, resulting in a total of 56 studies considered for review. Between PubMed, CINAHL, and reference search, eight of the articles were found to be duplicates and were removed. The remaining 48 articles returned were then selected for a full-text review to further determine eligibility for study. Of the remaining 48 articles, 40 were removed during the full-text review due to either blood pressure not being included as a measure of the study (13), the study was not conducted in patients with hypertension (6), yoga was not the primary intervention measured by the study (11), the effects of yoga on hypertension were not compared non-yoga participating control group (4), results for the study were unavailable at the time of review (2), or if the study was a systematic review or meta-analysis (4). At the conclusion of the full-text review, a total of eight articles were selected to be included in this systematic review. The process of selection of studies included is presented in Figure 1.

Results

Characteristics of Included Studies

The eight studies included in this review included 697 patients who had all been diagnosed with either pre-hypertension or hypertension. These studies consisted of seven randomized controlled trials and one matched controlled study. The majority of studies consisted of adults between 18 and 80 years old, with two of the studies consisting of a population with a minimum age of 30 and one study with a minimum age of 80. The combined age range of all participants included in these eight studies ranged from 18-80 years old. The primary

measurements recorded during the conduction of the included studies were systolic and diastolic blood pressure. One study included more specific and complex measurements of hemodynamics including mean arterial pressure, cardiac output, stroke volume, total peripheral vascular resistance, and baroreceptor sensitivity. Two of the studies included questionnaires to be completed by study participants. For the purpose of this systematic review, systolic blood pressure and diastolic blood pressure were the two main measurements considered when determining efficacy of findings on yoga's effect on blood pressure in participants of these studies. Between the eight included studies, there was variation between the length of the intervention period used in assessment of changes in blood pressure between yoga intervention groups and control groups. Four of the included studies consisted of yoga intervention for 12 weeks, with one of these four studies also collecting blood pressure measurements at 24 weeks and one collecting measurements at 28 weeks. One study consisted of a one-week intervention period and measurement, one study consisted of a six-week intervention period and measurement, and one study consisted of an eight-week intervention period and measurement. Additional information regarding the key findings of included studies is presented in Table 1.

Intervention of Yoga Practice

Among the eight included studies, there was a wide degree of variation in the methods yoga was implemented for the measurement of the effects on blood pressure. Six of the included studies incorporated yoga practice in a setting which included the presence of a yoga instructor who guided participants in the practice of yoga. Five of the included studies used a combination of yoga with an instructor and self-practice at home. On average, participants underwent 60 minutes per day of yoga practice per day. Yoga intervention was commonly made up of several exercises including yoga postures, breathing exercises, and relaxation techniques. Two of the

Table 1. Data Extraction of Included Studies

Authors, Year of Publication, Country	Study Design, Sample Size	Purpose of Study	Participants	Measurements Conducted	Major Findings
Cohen et al., 2016, United States	Randomized, nonblinded, prospective, controlled trial, 90	Assess the safety and efficacy of a 24-week structure yoga program vs BP educational program vs combined yoga and education	18–80-year-olds with prehypertension to stage 1 hypertension who were not taking antihypertensive medications for at least 3 months	Systolic blood pressure, diastolic blood pressure, and heart rate	Reductions in blood pressure in all 3 intervention groups, with a significantly greater reduction in systolic blood pressure among participants of the yoga and combination intervention groups
Cramer et al., 2018, Germany	Three-Armed Randomized Controlled Trial, 75	Compare the blood- pressuring lowering effect of yoga interventions with and without yoga postures in patients with arterial hypertension	>18 years old with primary arterial hypertension and receiving antihypertensive medication from their primary care physician or specialist at the time of investigation	Systolic and diastolic 24-hour blood pressures determined using an internationally accepted digital blood pressure monitor	At 12 weeks the systolic 24-hour blood pressure was significantly lower in the group without yoga postures than in the group with yoga postures. At 28 weeks the systolic 24-hour blood pressure in the group with yoga postures was lower than the control.

Hagins et al., 2014, United States	Randomized controlled trial, 64	Compare the effects of yoga to an active control in individuals with pre- and stage 1 hypertension	Individuals with pre- or stage between the ages of 21-70, medically stable on any medications	Systolic blood pressure, diastolic blood pressure, and heart rate	Yoga decreases blood pressure in patients with very mild hypertension
Metri et al., 2018, India	Comparative Study, 40	To study the efficacy of 1-week residential integrated approach of yoga therapy intervention on cardiovascular parameters in hypertensive patients	30-60 years old with a history of minimum 5 years of hypertension	Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, cardiac output, stroke volume, total peripheral vascular resistance, baroreceptor sensitivity	Significant improvement in systolic blood pressure, diastolic blood pressure, mean arterial pressure, baroreceptor sensitivity, and total peripheral vascular resistance compared to control group

Patil et al., 2017, India	Open-label, parallel-group randomized controlled study, 60	Compare the effects of yoga program and walking exercise on cardiac function in elderly with increased pulse pressure (PP)	> 60 years old with increased pulse pressure > 60 mmHg	Resting heart rate, ejection duration index, pre-ejection period, upstroke time, left ventricular ejection time, diastolic time, and rate pressure product	Yoga practice showed decreases in heart rate and ventricular afterload through reduction of blood pressure
Subramanian et al., 2011, India	Community-based Cross-over Randomized Controlled Trial, 94	Measure the independent and relative efficacies of physical exercise, salt reduction, and yoga, in lowering the blood pressure among young pre-hypertensives and hypertensives	Prehypertensive and hypertensive young adults aged 21-25 years	Systolic blood pressure and diastolic blood pressure	Showed significant diastolic blood pressure reduction with only yoga as an intervention

Wolff et al., 2013, Sweden	Matched controlled study, 83	Determine the effects of yoga on BP and quality of life in patients in primary health care diagnosed with hypertension	Adult patients (age 20-80 years) diagnosed with hypertension	Systolic blood pressure and diastolic blood pressure	No significant differences in change in systolic blood pressure between yoga groups and control groups. Significant improvement in diastolic blood pressure among yoga at home group compared to control group.
Wolff et al., 2016, Sweden	Randomized Controlled Trial, 191	Evaluate yoga's impact on blood pressure and quality of life and on stress, depression, and anxiety in patients with hypertension presenting to primary care physicians	30-80 years old diagnosed with hypertension identified by electronic charts from three healthcare centers in southern Sweden	Systolic blood pressure, diastolic blood pressure, WHOQOL-BREF quality of life questionnaire, PSS-14 questionnaire	No significant differences in mean change of either systolic blood pressure or diastolic blood pressure

included studies consisted of two separate yoga intervention groups. One of these two studies consisted of one yoga group with yoga postures, and one yoga group without yoga postures, which instead consisted of breathing exercises, meditation, and relaxation techniques. The other of these two studies consisted of one yoga group that practiced in a setting that was taught by an instructor and one yoga group that consisted of yoga practice individually in a home setting.

Evaluation of Systolic Blood Pressure

In all the included studies baseline systolic blood pressure was measured prior to beginning the interventions specified in each study for means of comparison following the intervention of yoga to control groups. In all but one study, systolic blood pressure was also measured after the completion of the intervention to measure the effects on yoga on systolic blood pressure. However, in one of the eight studies (Patit et al., 2017), the effect of yoga on systolic blood pressure was measured as rate pressure product (RPP), which is a function of heart rate (HR) and systolic blood pressure (SBP), calculated as $[RPP = HR \times SBP]$.

Among the included studies which consisted of only one yoga intervention group, baseline measurement of systolic blood pressure revealed an average value of 135 mmHg among members of the yoga intervention groups. Preintervention average systolic blood pressure among the two studies which consisted of two yoga intervention groups was calculated as 138.6 mmHg.

Following the implementation of yoga among the six studies that included only one intervention group, all six of these studies reported a noted decrease in systolic blood pressure. In one of these six studies (Patit et al., 2017), the decrease in systolic blood pressure was represented by a decrease in ventricular afterload and RPP. The average decrease in systolic blood pressure among these studies was 4.91 mmHg, a 3.6 percent decrease from the baseline systolic blood pressure measurements conducted before the introduction of yoga.

Among two studies that examined the effects of two yoga intervention groups (Cramer et al., 2018 and Wolff et al. 2013), there was variation in systolic blood pressure changes between each intervention group in both studies. In one study (Cramer et al., 2018), a decrease of 4.1 mmHg in systolic blood pressure was noted in the group who participated in the yoga with yoga postures group, however an increase of 1.6 mmHg was noted in the group who did not engage in yoga postures. These findings suggested that yoga postures are more beneficial to blood pressure control among hypertensive patients. In the other study (Wolff et al., 2013), variation in systolic blood pressure control varied based on the setting in which yoga was practiced. The group that participated in a yoga class showed an increase in systolic blood pressure of 0.3 mmHg, while the group that practiced yoga at home saw a decrease of 6.8 mmHg. The average decrease in systolic blood pressure among these groups was 2.25 mmHg, a decrease of 1.6 percent from the baseline. The variation in changes between intervention groups gives insight into what would be the best setting and method of practicing yoga to reduce blood pressure.

Evaluation of Diastolic Blood Pressure

Like systolic blood pressure, baseline diastolic blood pressure readings were performed prior to the practice of yoga in all but one of the included studies, in which case diastolic function was measured by calculating diastolic time. In the studies which utilized one yoga intervention group, the average baseline diastolic value was calculated to be 80.9 mmHg. Following the intervention of yoga practices, repeat measurement of diastolic blood pressure at the conclusion of all included studies revealed an average decrease of 3.16 mmHg, an average decrease of 3.8% from the baseline diastolic readings. It should be noted that all of the diastolic blood pressure readings following the intervention period decreased from the baseline. In the one study which measured the diastolic effects of yoga by measuring diastolic time (Patil et al.,

2017), diastolic time was increased by 8.3%, indicating improvement in diastolic function among yoga participants.

Among the two studies which included two separate yoga intervention groups, the average diastolic blood pressure among participants was 85.3 mmHg. Diastolic blood pressure was reduced in all groups except for one, in which yoga was performed in a class setting rather than at home (Wolff et al., 2013). The other three intervention groups all recorded decreases in diastolic blood pressure at the conclusion of the studies. The average decrease in diastolic blood pressure among these four intervention groups was calculated to be 1.45 mmHg, a change of 1.7% from the baseline diastolic readings.

Discussion

Upon examination of the changes in blood pressure recordings following yoga interventions, 62.5% (5 out of 8) of the included studies showed decreases in both systolic and diastolic blood pressure measurements, however, one of these studies (Wolff et al. 2016) reported that the changes noted following participation of a 12-week yoga intervention period were insignificant when compared to the control group who received normal treatment with a prescribed antihypertensive regimen. One of the studies included in this systematic review (Subramanian et al., 2011) only showed significant improvement in diastolic blood pressure measurements after participation in the study. Two of the studies included in this review showed differing effects of yoga practice on blood pressure due to the inclusion of two intervention groups which participated in each study. One of these two studies (Cramer et al., 2018), included one group which practiced yoga with postures and one group which practiced yoga without postures. Following the conclusion of the study, a reduction in both systolic and diastolic blood pressure readings was recorded in the group which participated in yoga postures. However, the

group without postures showed an increase in systolic blood pressure and no change in diastolic blood pressure, indicating that yoga with yoga postures is more effective at producing reduction in blood pressure than yoga without postures. In the other of these two studies (Wolff et al., 2013), one intervention group practiced in a group setting with an instructor while the other group was taught yoga techniques and instructed to practice teachings in a home setting. In the group which practiced in a group setting, an increase in both systolic and diastolic blood pressure recordings was noted, while the group who practiced yoga at home showed a decrease in both systolic and diastolic blood pressure, indicating the setting in which yoga is practiced has implications on the level of reduction in blood pressure.

During the completion of this systematic review, two specific limitations of the included studies were noted. One limitation found in the studies was the setting in which yoga was practiced. Several of the included studies were designed to have participants practice yoga interventions at home following instruction by someone educated on yoga techniques. Leaving individuals to practice at home increases the risk and likelihood of noncompliance among participants in following the parameters set forth by the study design. While some of the studies mentioned that compliance was monitored and participants who failed to adhere to the study parameters were excluded and their data was not considered when displaying results. While this may mitigate some of the discrepancies that may occur due to noncompliance, it is unlikely that it avoided them altogether. While many of the studies in which yoga was practiced in a home setting reported that yoga practice was effective in reducing blood pressure among hypertensive patients, there is room for error in calculations that may impact the outcome of the study.

Another limitation discovered during the review process was the complexity of yoga practice. Throughout review of individual studies analyzing the effects of yoga on blood

pressure, many variations of yoga practice were implemented throughout the various studies. Though this does make it more difficult to make a definitive declaration on the efficacy of yoga implementation into hypertension treatment, the results of the studies indicates that yoga practice in general, does lead to the reduction of blood pressure when implemented among patients diagnosed with hypertension, it does not allow for the determination of the most effective method of yoga practice to reach these results. More research could be conducted in the future to analyze the effects of various yoga practices to further determine the efficacy and make improved recommendations regarding therapies for treatment of hypertension.

The analysis conducted in this systematic review can be utilized in determining the future of antihypertensive therapies. With the data produced by the included studies, one cannot say definitively that yoga should be recommended as an alternative to conventional antihypertensive therapies such as antihypertensive medications and lifestyle changes such as diet and exercise. However, the results indicate that yoga is an acceptable method of improving blood pressure among hypertensive patients in combination with these traditional therapies. Implementation of yoga into a current antihypertensive treatment regimen is a relatively inexpensive method of reducing blood pressure, with low barriers to entry among patients of diverse backgrounds. As seen in several of the included studies, yoga has yielded positive results in blood pressure management in the home setting, which makes it easier for patients with hypertension to adopt yoga as a regular practice.

Hypertension is a common diagnosis among members of the older adult population, with 66.8% of Americans over the age of 60 having received a hypertension diagnosis (CDC, 2019). Older adults are also more likely to have multiple diagnoses which affect their health and require multiple forms of treatment to manage, often leading to the practice of polypharmacy, which can

lead to negative health outcomes among these patients. One method of reducing the pharmacological burden and risks associated with multiple diagnoses is the introduction of nonpharmacological therapies to improve the management of conditions. Through analysis of the included studies, yoga therapy is a strong candidate as a form of adjunct therapy for the treatment of hypertension, which can reduce the pharmacological burden among patients with hypertension and improve blood pressure control.

The results of this systematic review give insight into the future management of blood pressure among individuals diagnosed with hypertension. Considering the incidence and rates of hypertension that is uncontrolled by pharmacological therapies alone, it is important to consider alternative therapies to manage blood pressure. One such therapy is the participation in yoga, which has shown positive results in the reduction of blood pressure among patients diagnosed with hypertension.

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