

## Yoga and Hypertension: A Systematic Review

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### Abstract

**Introduction:** The objective of this systematic review is to study the effects of yoga in reducing blood pressure in adult patients with hypertension. Yoga is universally accepted as ancient practice in which you use breathing techniques, exercise and mediation. Yoga is increasing being practiced in studios and is widely being accepted as part of a wellness program in corporate companies. The focus of this literature review is to provide a summary and evaluation of the existing research and gain a new body of knowledge on the use of yoga to manage hypertension. This systematic review used the Health Belief Model as the theoretical framework.

**Methods:** CINAHL, PubMed, Directory of Open Access Journals, Academic OneFile, MEDLINE, Science Citation Index and EBSCO Host. Search criteria randomized clinical trials, peer-reviewed papers, systematic and meta-analysis articles between 1993 and 2017.

**Results:** Eleven studies were reviewed with 957 total participants. There are six randomized clinical trials, two matched controlled and three interventional studies. Two types of yoga were specified, in the studies, eight were not. Two of the eleven studies showed no significant change in systolic and diastolic blood pressure.

**Conclusion:** Through the studies analysed, it can be concluded that practicing yoga can reduce systolic and diastolic blood pressure.

**Keywords:** Hypertension; Yoga; Systolic and diastolic hypertension; Complementary alternative medicine; Lifestyle; Essential hypertension; Adult and Blood pressure.

### Introduction

Hypertension is a major health risk factor for heart attack and stroke and is third leading cause of death in the United States. High blood pressure is called the “silent killer” because it often has no warning signs or symptoms. According to the World Health Organization, hypertension is considered a global health problem and is one of the major causes of death. There are 76.4 million adult Americans with hypertension, which costs the nation \$48.6 billion each year. This total includes the cost of healthcare services, medications to treat high blood pressure and missed days of work [1]. The cost of medications and non-adherence to medications has contributed to the high rates of uncontrolled hypertension. Yoga is an alternative practice and cost-effective method to manage hypertension. The purpose of this systematic review is to determine if yoga practice is an effective intervention to treat and manage elevated blood pressure in adults age 18 to 65 years old diagnosed with essential hypertension.

### Problem statement

Hypertension is a multifactorial disease that affects 75 million American adults [2]. Hypertension is a major cardiovascular risk factor that can result in serious consequences to organs and is considered a serious public health problem due to its chronicity and high costs of hospitalization [3]. The main risk factors for hypertension include: heredity, age, ethnicity, obesity, stress, sedentary lifestyle, alcohol consumption, gender, use of contraceptives and high sodium intake. The treatment of hypertension has relied heavily upon pharmaceutical interventions, including beta blockers, angiotensin-converting enzyme inhibitors, thiazide, calcium channel blockers, diuretics, angiotensin II receptor blockers, renin inhibitors and mineralocorticoids [4]. While pharmaceutical intervention has been shown to lower blood pressure, little research is known about how alternative therapies and lifestyle change can alter or lower blood pressure when used in combination with

a medication or even as a preventative measure [5]. While medication has been proven to lower blood pressure in some, many people still struggle with high blood pressure because they are not changing the underlying causes contributing to their hypertension. A large barrier of utilizing medication for comprehensive treatment of hypertension includes medication compliance [6]. Through a qualitative study, it was found that the two largest factors related to noncompliance include; a lack of basic knowledge regarding hypertension itself and fear of taking antihypertensive medication [2]. With a misunderstanding of medication at the center of hypertension noncompliance, providers must look to another treatment method of this disease to promote patient adherence.

Complementary and Alternative Medicine (CAM) are an alternative healthcare treatment that includes mind-body therapies and have been proven to positively affect blood pressure [7]. Included in complementary alternative medication therapies, is the practice of yoga. Yoga was developed by the Indus-Sarasvati civilization in Northern India over 5,000 years ago [8]. Yoga provides a mind and body practice that can advance muscle strength and tone, reduce weight, improve cardio and circulatory health and offer a wide variety of mental as well as physical benefits. Yoga modulates the physiological system of the body and can lower an individual's heart rate and increase blood flow to extremities [7]. Yoga provides benefits without drug interactions or

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harmful side effects. On an individual patient basis, research must be considered to determine whether yoga or pharmaceutical interventions are more effective in treating and maintaining hypertension patients.

## Literature Review

Hypertension is defined as a systolic blood pressure of greater than 140 over a diastolic blood pressure of over 90 [1]. Many Americans live with chronic hypertension and a significant portion of those are unaware they have high blood pressure. High blood pressure has significant detrimental effects on health and wellbeing, so it is imperative that all treatment options are explored. Currently, there are strict guidelines for treating hypertension set forth by the Joint National Committee (JNC III); these recommendations include lifestyle modifications and pharmacological interventions. The most common pharmacological interventions include thiazide diuretics, Angiotensin-Converting Enzyme inhibitors (ACE), Angiotensin-receptor blockers (ARB) and Calcium-Channel Blockers (CCB) [9]. Though there are strict guidelines for the treatment of high blood pressure, a large portion of American adults remain hypertensive suggesting an area for improvement in hypertension management.

A study from analysed data from 2003-2010 and determined that approximately 30.4% of adult Americans are living with hypertension; of those individuals with hypertension, 53.5% did not have their hypertension controlled. Significant portions of individuals with uncontrolled hypertension were unaware of their elevated blood pressure [1]. Many of the participants were taking pharmacological interventions for their blood pressure, yet still remained hypertensive. These numbers suggest that while there are current solutions to manage high blood pressure, there is still a large percentage of the population struggling with hypertension.

It has long been known that uncontrolled hypertension can lead to myocardial infarction, heart failure and stroke, but more recently, studies have been finding further complications of hypertension [10]. Atrial fibrillation is an irregular heart rhythm characterized by quivering of the atria that is not synchronous with the ventricles [11]. While many people chronically live in atrial fibrillation, it can be a serious and life threatening disease. The American Heart Association estimates that atrial fibrillation doubles the risk of heart cardiac related deaths and increases the likelihood of stroke by five times. A study examining the relationship between hypertension and atrial fibrillation was done at a hospital in Pakistan. This prospective study analysed the rates of atrial fibrillation in hospitalized patients with long-standing hypertension. Researchers found that the group who suffered from hypertension for over 15 years had a 70% rate of atrial fibrillation. More specifically, the mean systolic blood pressure of those with atrial fibrillation was 154.95 and the mean of patients without atrial fibrillation was 147.98 [12]. This study shows a significant relationship between rates of atrial fibrillation and hypertension and further demonstrates the dangers of hypertension and cardiac related illness.

Stressing lifestyle modifications before prescribing medication is the recommended initial treatment for hypertension. A study from Europe highlights the importance of lifestyle counselling while attempting to manage Cardio-Vascular Disease risk (CVD) in middle-aged men. In this study cardiovascular risk was determined by BMI, smoking status, physical activity and blood pressure. Broken into 3 groups, the men were reassessed 5 years later and CVD risk was measured again. The 3 groups were men having been seen regularly by a primary care provider, occupational health provider, or no visits to a health care provider. The researchers found that after 5 years, groups with the

greatest reduction in CVD risk were those men that saw a primary care provider and regularly engaged in counselling related to their CVD status [13]. Lifestyle counselling and open dialogue by primary care providers about their patient's cardiovascular risk components, such as blood pressure, can be an important and beneficial approach in reduction of CVD risk and cardiovascular adverse events. While it has been well studied that hypertension can lead to stroke, myocardial infarction and heart failure, more current studies shows further complications [11-13]. Both Siren and Ahmed's studies reveal that even with all the information and research we have today, there continues to be new information emerging that illustrates new problems associated with hypertension.

In addition to cardiac issues, hypertension can affect many other aspects of health and wellness. In a large study of 590 participants, rates of hypertension and depression were examined. Unlike Siren or Ahmed's work, Almas' study focused more on the psychological effects of blood pressure rather than the physiological aspects [14]. This study found that there is a significant correlation between hypertension and depression that is independent of other factors such as demographics and comorbidities. It was found that while there is an association between the two, they are still unsure of the causation. Some possible theories the authors suggest is that the constant physiological stress that hypertension puts on the body could lead to psychological stress, or that the patient might develop hopelessness about their chronic illness of uncontrolled hypertension leading to depression. It was concluded that more research needs to be done in order to clearly explain this phenomenon, demonstrating that there are still new and dangerous aspects of hypertension that are continuing emerge [14].

Medication compliance is a constant issue in healthcare for any type of pharmaceutical intervention. A study conducted by Richardson looked at perceived anti-hypertensive medication compliance. The study found that 47% of the participants were non-compliant with their blood pressure medication [15]. Medication compliance is a big topic in healthcare and will likely always be problematic unless there are alternative options to pharmacological interventions. More current literature shows that compliance is still an issue today. For example, a recent cross-sectional study revealed the biggest predictors of noncompliance with blood pressure medications in hospitalized patients. Poor medication adherence was associated with unawareness about hypertension and its dangers, side effects of blood pressure medications and lack of knowledge about blood pressure goals [16]. Richardson's research demonstrated that medication compliance was a problem over 20 years ago and Macedo's research similarly shows that it continues to be an issue. With hypertension's continued compliance problems, it is important to consider other ways to treat hypertension besides pharmacological interventions.

An important aspect to consider when looking at alternatives to blood pressure medication is the shift in the way people view holistic health today. In recent years, a larger portion of the United States population is converting their lifestyle to a more natural, pharmaceutical-free life than in the past. In a research study by, the author highlighted the recent "*paradigm shift for holistic health practices*," and examined views on holistic health through participant surveys. Nursing students who participated in a holistic health class were surveyed roughly 1-7 years after the course and rated their feelings towards the class. The study found that 52% of the students use the learned information "frequently" in their personal lives and 42% in their professional lives [17].

While the general United States population switches to a more naturalistic approach to healthcare, the medical field has begun to follow

suit. The shift to holistic methods was explored within the medical fields and found that cost and quality concerns were the driving force behind the change of practice [18]. Holistic medicines and practices are more often cheaper for the patient as well as the medical facility and prove to have fewer side effects than their medicine counterparts. Attributing to the high cost of medicine is medical product waste. In 2012, it was estimated that 30 cents of every dollar spent on medical care in the United States was wasted, amounting to \$750 billion wasted annually [19]. With diet and exercise reinforcement being pushed as the initial physician response to deterring chronic illnesses, the practice is moving away from pharmacological approaches.

While many studies researched the effects of medication on hypertension, some researchers examined alternative treatments to the disease. In a cross-sectional study carried out through primary care clinics in Singapore, 488 patients with chronic disease diagnoses were interviewed regarding the use of Complementary Alternative Medicine (CAM). Complementary alternative medication is a category of medicine that includes a variety of treatment approaches that fall outside of the realm of conventional medicine [20]. Within the Asian culture, CAM use is standard with practices often passed down throughout the family. Lee et al. [20] found that 22.7% of the participants consistently utilized complementary alternative medications as the sole treatment for their chronic disease. CAM use was found to have a higher prevalence in individuals with factors including: middle age, arthritis, musculoskeletal disorders and stroke, multiple conditions, poor perceived health, family use of CAM, recommendation by close social contacts, strong adherence to traditional health beliefs and perceived satisfaction with care. Patients who were dissatisfied or very dissatisfied with the cost of treatments and the waiting time were more likely to use CAM, while patients who were satisfied from the benefits of treatments were less likely to use CAM. Satisfaction with the physician caring for the individual was found to not have any effect on CAM use [20].

Complementary alternative therapy is a broad heading, including many beneficial practices to general health and wellbeing. One of these therapies includes yoga, which is an exercise that has been steadily increasing in popularity within the US over the past few decades. According to a study in the American Journal of Preventative Medicine, the use of yoga has increased by 6% nationwide since 1988. This study also showed that 78.4% of people practicing yoga regularly self-reported an overall improvement in their "general well-being". Other findings of the study say that the majority of the participants practicing yoga reported an increased "sense of control over their health" along with many other physiologic health improvements [7]. Probably one of the most important aspects of this study is that one third of those who have tried yoga had told their primary care provider about it. This demonstrates the importance of primary care providers understanding the health benefits associated with yoga along with options and alternatives to discuss with patients about their health concerns.

Looking further into the practice of yoga, [21] formed a cross-sectional design with anonymous online surveys, aimed to describe yoga practice and health characteristics of individuals who practice yoga, as well as explore their health beliefs regarding the effects of their yoga practice on their health. Participant ranged from 19 years old to 81 years old, with 82.4% female, 89.2% Caucasian and 87.4% well educated with a bachelor's degree or higher. 4.9% of participants were obese and 2% were smokers. 84.6% of participants agreed that yoga improved energy, 84.5% happiness, 68.5% sleep, 53.7% weight and 67% social relationships [21].

Yoga has many perceived benefits, such as increased happiness

and social relationships, as well as numerous health related avails. Yang conducted a systematic review that observed different health components of yoga practice. The study suggests that participants who regularly adhered to a yoga program had a decrease in body weight, lowered their blood glucose level and lowered their cholesterol levels [22]. Sui looked at yoga health benefits in individuals diagnosed with metabolic syndrome and found favourable results for the addition of yoga to one's exercise regimen [23]. A 1-year yoga program was started for those in the study and found that "*waist circumference was significantly improved*," and a decrease in systolic blood pressure was observed. These studies had positive implications for metabolic and cardiovascular health related to yoga practice [23].

Historically, in common medical practice, physicians made a diagnosis, considered the management alternatives and informed patients what could be done to help them. Decision-making rested exclusively in the physician's domain. Liddy et al. [24] conducted an integrative review to examine the challenges of self-managed care in multiple chronic conditions within a family healthcare clinic. The researchers found three key challenges to self-managed care among the 354 participants; contradictory knowledge, the complexity of social support and lack of financial resources. The physicians did not seem to be educating their patients as adequately as the patients would like and some even described intimidating doctor-patient relationships with "contradictory knowledge, miscommunications and lack of overall interest by the physicians" [24]. In order for patient centered care to be effective, patients must be well-informed and comfortable with their healthcare providers.

In order to provide patient centered care, the medical care provider has to communicate well with the patient. Tailoring interventions and medication to patient's individualized situations are extremely important. Another key theme within the research was the sharing of power and responsibility in healthcare. Healthcare practice has always relied primarily on the physician's expertise, but when the patient is aiding in the process the responsibility of carrying out medication and previously decided upon interventions become shared.

There is significant research that indicates hypertension is still and will continue to be one of the leading chronic conditions in the U.S. [11]. This presents the issue of how such a well-studied and researched disease continues to be a problem, even while there are pharmacological treatment options available. Cramer [7] discovered that current hypertension management techniques are not sufficient enough to manage the problem and a multidimensional approach to treating high blood pressure is necessary. This problem opens up an opportunity to explore non-pharmacological interventions to treating hypertension. Primary care providers, such as nurse practitioners, are often one of the first people that patients ask about exercise, medical and other health related choices and therefore should be and up to date on all current methods of hypertension management. With its popularity growing and its health benefits well studied, yoga is a reasonable complementary and alternative medical therapy to consider and investigate the effects it has on blood pressure. Despite its many potential health benefits, yoga is not a widely accepted treatment option for hypertension warranting further research of this alternative medical therapy for blood pressure management.

Within healthcare practice, there are many approaches to individualized as well as effective care. In patients with hypertension, yoga may not always be the first suggestion in management. However, there is research to support its effectiveness in managing blood pressure

as preventative measure, an adequate management technique for mild hypertension and in concurrent use with medication. Emotionally and physically this practice provides numerous benefits and should be considered when adapting a patient's personalized care.

### Search methods

The literature review strategy for this study was executed by CINAHL, PubMed, Directory of Open Access Journals, Academic OneFile, MEDLINE, Science Citation Index and EBSCO Host. Search criteria included clinical trials, peer-reviewed papers, systematic and meta-analysis articles between 2004 and 2010. The data search included the following key words: hypertension, yoga, systolic and diastolic hypertension, complementary alternative medicine, lifestyle, adult and blood pressure. Inclusion criteria consisted of ages and gender, any form and length of yoga and those with essential hypertension. Exclusion criteria consisted of other forms of hypertension being studied such as pulmonary hypertension or gestational hypertension, paediatric studies, use of yoga therapy for other comorbidities such as cancer or diabetes mellitus with a blood pressure component and studies that were focused on meditation and breathing rather than yoga.

The included studies were from various regions of the world; India, United States, Australia, Sweden, etc. In the selected studies there were a total of 957 participants with ages ranging from early 20's to 80's. Depending on the study, participants were recruited from a variety of settings, including yoga centres, cardiology clinics and non-specific healthcare offices. A majority of authors specifically stated that informed consent was obtained, as well as going through their country's ethical clearance, while only one study did not mention ethical consideration at all.

### Theoretical framework

The Health Belief Model helps identify why certain people are more inclined to reject or accept preventive health services or implement healthy behaviours. This theory was originally developed to better understand the motivation and decision making process for health behaviours and choices. There are 4 main components of the theory: severity of a potential illness, the person susceptibility to that illness, benefits of taking a preventative action and the barriers to taking that action [25]. This theory relates to the problem of hypertension in a few ways. Hypertension is a common and severe illness, but there are many preventative actions people can take to avoid and treat high blood pressure. There are many current treatment options for high blood pressure, yet it still remains a large issue indicating that there are barriers to compliance and other health related factors involved. The Health Belief framework may help explain health-seeking behaviours when it comes to the treatment of hypertension.

A related study examined weight management barriers in young adults using the Health Belief Model. In this qualitative study, first-year college students were interviewed to help identify perceived challenges to weight management during their time in college. It was based on the framework and idea that weight gain is a preventative problem with a decision-making component. This study found that men typically felt their barriers to weight loss were external factors, such as lack of resources and information. Women felt their barriers were based more on internal factors, such as poor time management [26]. This study further illustrates the importance of patient perceptions on barriers to compliance and their motivation that determines preventative health measures. This is similar to hypertension management because patients must determine whether they perceive the severity of the issue as a potential problem for themselves, what the benefits would be if they

decreased their blood pressure and what barriers and challenges there are for them to take action on it.

### Methodology

A systematic review is a structured, comprehensive and meticulous summary of findings. It is an overview of primary studies with the goal of identifying new knowledge on a particular topic. One advantage of a systematic review is the ability to limit bias and to draw reliable conclusions leading to a definitive answer to a question. A disadvantage to a systematic review is bias in the selection of articles and conflict with new experimental data [27]. A systematic review of published studies was performed. Of the eleven studies analysed, one study accompanied yoga practice with medication, while the other studies utilized participants not currently taking blood pressure medications. Amongst participants in the trials, systolic blood pressure ranged from 120.3 to 158 before beginning the intervention of yoga. Two studies applied the specific yoga type Kundalini, while one used Bikram. The eight other studies did not specify their precise yoga practice. After the intervention, systolic rates lowered to a range of 117.6 to 145.4. Diastolic blood pressure prior to yoga practice ranged from 74.7 to 100.3, compared to the after yoga range of 73.5 to 87.73. Two of the eleven studies showed no significant change in systolic and diastolic blood pressure. The collected data from the articles included: study design and tools, sample size, description of the study population and blood pressure outcomes. Systolic and diastolic blood pressure in adults was analysed that utilized yoga. The chart below describes the research design and framework for conducted for each study reviewed. In addition, a detailed explanation of data collection method is presented.

Eleven studies were reviewed with 957 total participants. A total of six randomized clinical trials, two matched controlled and three interventional studies met the inclusion criteria. Two types of yoga were specified in the studies, eight were not. Studies had participants practice yoga from 21 to 120 total days of duration. Two of the eleven studies showed no significant change in systolic and diastolic blood pressure. These studies show that yoga is an effective complementary therapy for hypertension. The reviewed studies are presented in Table 1, which compares the 11 research studies through purpose, sample size, sample type, clinical measures, research design, yoga intervention, blood pressure results, significance and limitations.

### Discussion

Researching yoga as a method to reduce hypertension is important due to the limited number of studies that focus specifically on yoga. When the results of all 11 studies were reviewed, as shown in Table 2, the research recognizes that those with hypertension can benefit greatly from adapting yoga as a practice to decrease blood pressure. Our review attempted to provide new insight into the therapeutic benefits of yoga on hypertension. The major finding of the study found the yoga had a positive effect in lowering blood pressure in adults with hypertension. Yoga demonstrates an effect on blood pressure by modulating the physiological system of the body, specifically on the heart rate. Systolic and diastolic blood pressure was reduced, reflecting meaningful improvements, as represented in Figure 1. Yoga as non-pharmacological method has a positive effect on physical as well as emotional wellbeing. Many participants who were in adherent to a strict yoga schedule reduced their BMI and waist circumference.

### Limitations

Gender has to be considered as a limitation within these studies. The

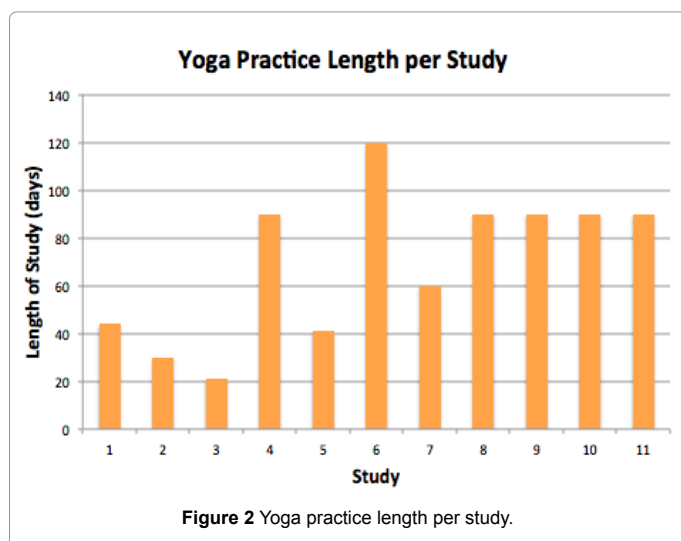
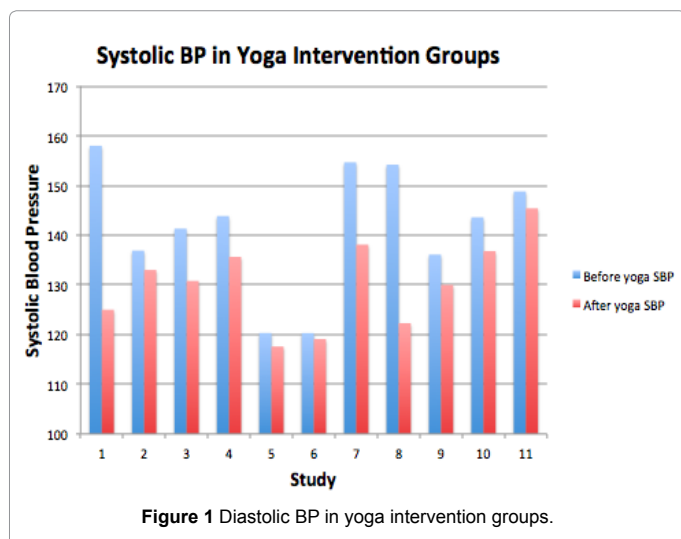
Citation APA	Purpose	Sample number	Sample type	Clinical Measures	Research Design	Yoga intervention	Blood Pressure Results	Significance	Limitations	Data base
Agarwal et al. [28]	"to observe the effect of yoga along with medicines on hypertension, for better management"	n=40, Age 20-65, gender not specified	Convenience sample: Participants chosen from OPD Cardiology Center.	BP, headache, palpitations, fatigability, irritability, edema, vertigo, insomnia	RCT	90minutes/day, 7days/week, 6 weeks **both groups initiated drug therapy prior to study with recommended doses of either Atenolol or Amlodipine. Control group: medication only, Yoga intervention group: medication & yoga practice	Control group BP before: 156.30/97.6, control group BP after: 143.5, yoga group BP before: 158/97.6, yoga group BP after: 125/82.2	Sig. for both control and yoga groups for SBP & DBP, also Sig. for SBP & DBP difference between groups	Highly vulnerable to selection bias, potential for under representation	Science Citation Index
Chauhan et al. [29]	"to evaluate the effect of 1 month yoga practice on body mass index and blood pressure"	n=90, experimental n=64 (25males 39 females), control group n=26, avg age 53.6 (range 22-69)	Convenience sample: Participants chosen from free yoga camps organized by university.	BMI, BP	RCT	60 minutes, 7 days a week for 1 month	Experimental before yoga: 136.9/84.7, experimental after yoga: 133/82.34. Control before yoga: 136.45/84, control after time: 136.36/83.9	Sig. for SBP & DBP	Highly vulnerable to selection bias, potential for under representation	Directory of Open Access Journals
Das et al. [30]	"to find out the effects of Integrated Approach of Yoga (IAY) on Essential Hypertension"	n=120, Age 21-65, gender not specified	Convenience sample: Participants chosen from subjects attending the Cardiology OPD of AIIMS.	SBP, DBP, BMI, HR, RR, HAR (Hamilton anxiety rating scale)	RCT	75 minutes/day every morning x 3 weeks. Control group: advised to walk 30 minutes/day 5 days a week for 3 weeks.	Control group before: 139.17/94.87, control group after: 138.70/92.5, Yoga group before: 141.33/93.73, yoga group after: 130.80/87.73	Sig. for SBP & DBP	Highly vulnerable to selection bias, potential for under representation	Directory of Open Access Journals
Devi et al. [31]	"to assess the effect of yoga on heart rate and blood pressure in mild hypertensive patients who are not on any form of medication"	n=50 (28 males and 22 females) Age 25-65.	Convenience sample: Participants chosen from those who came to practise yoga at YTRC.	resting HR, resting BP, HR response to tanding, BP response to standing, valsalva ratio, BP response to sustained handgrip	Interventional study	60 minutes/day, 6 days/week for 3 months	Before yoga: 143.86/89.08, After yoga: 135.64/84.64	Sig. for SBP & DBP	No control group, Highly vulnerable to selection bias, potential for under representation	Academic OneFile
Divya et al. [32]	"to evaluate the effect of short term yoga practice by healthy volunteers on cardiovascular function, pulmonary function, body mass index, blood glucose, lipid profile and thyroid function"	n=50, ages 22-55, gender not specified	Voluntary sample: Participants at a yoga studio volunteered to be in study.	serum cholesterol, serum triglycerides, HDL, LDL, TSH, T3, T4, ECG, PFT's (FVC, FEV, PEFR), heart rate, systolic BP, diastolic BP, Fasting blood sugar, BMI	Interventional study	75 minute/day, 6 days/week for 41 days	Before yoga mean: 120.32/80.44 After yoga mean: 117.6/79.24	Sig. for SBP & DBP	Lack of control group, unforseen lab errors, volunteer bias, cannot be generalized due to sample	Academic OneFile
Hewett et al. [33]	"to investigate the effect of a bikram yoga intervention on the high frequency power component of heart rate variability and associated cardiovascular disease risk factors in stressed and sedentary adults."	n=63, (14 male, 49 female), control n=34, n=experimental 29, Age 26-50	Convenience & Snowball sample: Participants were recruited by using flyers and by word of mouth referral.	HR, SBP, DBP, augmentation index, total cholesterol, HDL, LdL, triglycerides, FBG, Body weight, BMI, waist circumference, fat mass, lean mass, fat free mass, body fat	RCT	90 minutes, 3-5 classes/week, 16 weeks	Before yoga:120.3/74.7, After yoga: 119.1/73.5	No sig. for SBP & DBP but "significant associations" in DBP	Low attendance with participants attending only avg. 1.7 classes/week. Cohort may have been too low risk to see adaptation in certain measures such as BP, Highly vulnerable to selection bias, potential for under representation	MEDLINE

Nejati et al. [34]	"to assess the effect of group MBSRP and conscious yoga on lifestyle, coping strategies and systolic and diastolic blood pressures in patients with hypertension"	n=30 (12 women, 18 men) mean age 43.66, ages 30-55	Convenience sample: All patient who referred to the hospital with a diagnosis of htn were recruited for the study.	BP, Lifestyle questionnaire, coping strategies	RCT	90 minutes/day, 1 day a week for 2 months.	Before yoga control: 154.82/90.34, After yoga control: 157.16/92.31, Before yoga experimental: 154.67/90.58, After yoga experimental: 138.11/86.14	Sig. for SBP & DBP	Short follow up period, inability to perform a comprehensive sampling of all urban areas limiting the scope to only one hospital, Highly vulnerable to selection bias, potential for under representation	Directory of Open Access Journals
Satyanand et al. [35]	"aimed to evaluate the effectiveness of yoga in the treatment of high blood pressure"	n=100, Age>18, gender not specified	Convenience sample: Patient recruited from outpatient Cardiology department.	BP	Matched controlled trial	60 minutes/day, 7 days/week, 12 weeks along with weekly doctors visits for both groups	Control group BP before: 155.3/100.2, Control group BP after: 127.5/84.4, Yoga group BP before: 154.2/100.3, Yoga group BP after: 122.3/81.7	Sig. for both control and yoga groups for SBP & DBP	Highly vulnerable to selection bias, potential for under representation	Academic Search Complete
Sonwane et al. [36]	"to show the effects of yoga and pranayam on auditory and visual RT and on certain physiological parameters such as weight, BMI, pulse rate, respiratory rate, systolic blood pressure and diastolic blood pressure in normal and hypertensive subjects."	n=140 (70 normal, 70 hypertensive), ages 30-60, gender not specified	Voluntary sample: For control group, not specified for intervention group.	weight, BMI, HR, RR, SBP, DBP, ART, VRT	Comparative interventional study	90 minutes/day, 7 days/week, for 3 months	Before yoga normotensive: 116.45/76.02, Before yoga hypertensive: 136.11/88.0, After yoga normotensive: 112.05/71.73, after yoga hypertensive: 130.0/82.25	Sig. for SBP & DBP in both hypertensive and normotensive groups	Highly vulnerable to bias due to sampling, cannot be generalized to larger population, potential for under representation	Academic OneFile
Wolff et al. [37]	"to assess the benefit of two yoga interventions on inflammatory biomarkers and metabolic risk factors in a high risk population in primary care"	n=83 (55 female, 28 males), avg age 60-66	Simple random sample: Adult patient with htn were selected by electronic charts at a health care clinic and Sweden.	BMI, waist circumference, BP, health status and quality of life, other blood tests,	Matched controlled trial	split into 3 groups (control, yoga at home, yoga class) control group- no intervention, yoga group 1 met once a week and did 60 mins of yoga with instructor, then asked to practice yoga 30 minutes a day at home in addition, the yoga 2 group were each given a doctors appointment during which they recieved instructions for 2 yoga exercises to perform at home for a combined total of 15 mins a day, all groups for a total of 12 weeks	Yoga group 1 before: 143.8/ 89 Yoga group 1 after: 143.6/89.3 Yoga group 2 before: 143.6/88.4 Yoga group 2 after: 136.8/84	No sig. for yoga group 1 but Sig. for SBP & DBP in yoga group 2	Some patients (92%) already on antihypertensives so difficult to determine whether that was why the lack of significant BP results, single form of yoga studied, participants were matched at a group level and not randomized, some self reported data with how much patients were actually doing yoga	Science Citation Index
Wolff et al. [38]	"to evaluate yoga's impact on blood pressure and quality of life and on stress, depression and anxiety in patients with hypertension in a primary care setting"	n=191, 99 women, 92 men, mean age 64.7years	Simple random sample: Adult patient with htn were selected by electronic charts at a health care clinic and Sweden.	BMI, waist circumference, SBP, DBP, perceived stress scale, WHO (quality of life), HAD (hospital anxiety and depression)	RCT	15 minutes, 2 times/day, 12 weeks	Control group BP before: 150.0/88.1, control group BP after: 145.2/84.9, Yoga group BP before: 148.8/88.3, Yoga group BP after: 145.4/86.3	No sig. in either group	only one type of yoga intervention tried, self reported data on anxiety/ depression- always room for uncertainty in reporting	Science Citation Index

Table 1 Analysing the articles.

Total Studies	11
Total Participants	957
Study Type	6 RCT, 2 Matched Control, 3 Interventional
Sample Type	7 Convenience sample, 2 voluntary sample, 2 simple random sample.
Yoga Type	2 Kundalini, 1 Bikram, 8 not specified
Length of Yoga Practice Range	21-120 days.
Average length of Yoga practice	mean=69.63 days, median=90 days, mode=90 days
BEFORE yoga Systolic BP Range	120.3-158
BEFORE yoga Diastolic BP Range	74.7-100.3
BEFORE yoga Average BP	141.64/88.71
AFTER yoga Systolic BP Range	117.6-145.4
AFTER yoga Diastolic BP Range	73.5-87.73
AFTER yoga Average BP	130.34/82.73
Significant studies	9 Sig. studies for SBP & DBP, 2 non Sig. studies

Table 2 Total study summary.



perception of yoga as a complementary alternative medicine practice differs between men and women. The majority of the participants were women in the studies. Typically, men think of yoga as something women do and may not feel as comfortable with the practice. Gender can have

an effect on the adaptation of yoga as a CAM, resulting in skewed efficacy. Another limitation is the variability in the different forms of yoga practice, diet and yoga experience amongst the participants. Eight of the included studies did not specifically state the type of yoga practice that was implemented. Results found that a majority of the studies were from select small populations and age ranges. This can lead to findings that are unable to be generalized. Ethnicity of the participants was not disclosed in any of the studies, while six of the eleven studies listed this as a limitation. Hypertension varies substantially across ethnic background and is valuable information to incorporate in order to conclude more accurate results [39]. One study included patients that were already prescribed antihypertensive medications and four studies did not specifically state the baseline general health of their participants. Varying baseline health amongst study participants can cause the results to not be generalizable. Data collected was often directly from self-reported questionnaires. While self-reported measures are often easier to implement and cost effective, they are not always reliable. The length of the trials in each study varied from 21 to 120 days in length (Figure 2). Concluding that, the members of each study were not exposed to the same amount of yoga as others.

### Implications for FNP practice

The findings of this systematic review support the use of yoga as a complementary alternative medication in preventing and controlling hypertension. Firstly, educating patients about the hypertension. Second, stress the importance of being screened for hypertension. Lastly, adhering to a proper diet, medication and exercise regimen. In 2014, the Eighth Joint National Committee (JNC-8) released guidelines for healthcare providers to follow in order to adequately manage a patient's hypertension based upon their individual needs [40]. These guidelines recommend initiating lifestyle modifications in patients over eighteen years old, with hypertension. Throughout the algorithm, lifestyle modifications are reinforced and adherence is stressed, even when pharmacologic therapy is not lowering blood pressure. Family Nurse Practitioners (FNPs) can recommend patients with a history of hypertension, or that are exhibiting signs of prehypertension, to begin practicing yoga as long as they are physically able. This exercise is cost effective and can be practiced anywhere. There are numerous online resources dedicated to teaching the practice of yoga from beginners to expert levels. As long as the patient shows adequate evidence of efficacy of yoga practice, this is a beneficial CAM to implement in a patient's everyday life.

## Conclusion

Through the studies analysed, it can be concluded that practicing yoga can reduce systolic and diastolic blood pressure. With eleven total studies reviewed, two different types of yoga were specified, in the studies, eight were not. Two of the eleven studies showed no significant change in systolic and diastolic blood pressure. In the trials, systolic blood pressure ranged between 120.3 and 158 before the practice of yoga was implemented. After this intervention was administered, rates lowered to 117.6 and 145.4 amongst participants. Diastolic blood pressure prior to yoga practice ranged from 74.7 to 100.3, compared to the after yoga range of 73.5 to 87.73. A majority of trials found that there are numerous benefits of yoga, both mentally and physically. Study participant's weight, waist circumference and/or body mass indexes was decreased as a result of yoga implementation in over half of the studies included. There is still a genuine need for more randomized controlled trials to assess the effect of yoga on persons with a family history of hypertension, prehypertension and a diagnosis of hypertension. Utilizing the studies available, it can be concluded that yoga is an adequate lifestyle modification that a Family Nurse Practitioner can recommend to a patient, in order to treat prehypertension or accompany pharmacological therapy in essential hypertension.

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