

Scoping Review



Impact of *Pranayama* practices on Blood Pressure in Hypertensive Adults: A Scoping Review of Emerging Evidence from Randomised Controlled Trials

[1Bawadkar Prasad](#), [2*Suketha Kumari](#), [3Aashish Patel](#), [4Durge Sushma](#),
[5Aayushi Soni](#), [6Patil Prayer](#)

ABSTRACT:

Background: Hypertension (HTN) is a major worldwide health problem that is associated with cardiovascular morbidity. Pharmacological therapy is of benefit, but it is difficult to maintain blood pressure control in long term, owing to poor compliance, side effects and/or long-term requirement of therapy. *Pranayama* has been emerged as an adjunct in regulation of blood pressure. **Objective:** This study summarizes evidence of Randomised controlled trials (RCT's) from major databases which access the impact of *pranayama* in HTN. **Methodology:** PubMed, Scopus and Cochrane Central databases were systematically searched up to June 2025 since inception and only RCTs were included to generate synthesis based on highest level of clinical evidence. Data were summarized in terms of study characteristics, study participants, intervention protocol, research outcomes and significant research findings. Since interventions and outcomes were heterogeneous, synthesis of the evidence was performed descriptively. **Result:** After screening, 6 RCT's evaluating the impact of *pranayama* on blood pressure able to pass inclusion criteria. Despite the limited number of RCTs, consistent evidence indicate that *pranayama* technique plays a significant role in lowering blood pressure, proves its clinical relevance and therapeutic benefits. Studies were heterogenous and showed sampling, application, period and demographical limitations. Novelty of this review is, as it uses large database RCT's, offering a comprehensive overview of pragmatic and easily applicable *pranayama* practices as an adjuvant in HTN, at the same time identifying the research gap and guiding future direction. **Conclusion:** Based on the available RCT's, it can be concluded that *pranayama* practices support its use as an adjuvant treatment in the management HTN. This review also addresses the gaps in scientific literature, providing a future direction for high quality, multi-centric studies with rigorous methodology. This ensures broader applicability and sustainability, thereby providing valuable guidance for clinicians and public to incorporate pranayama in HTN management

KEYWORDS: Pranayama, Hypertension, Blood Pressure, Randomized Controlled Trials, Scoping Review

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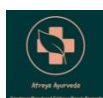
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Corresponding Author Email:

sukethashetty411@gmail.com

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1. INTRODUCTION

Hypertension (HTN), a common global health concern, have consequences of cardiovascular disease and its complications (stroke, early mortality and kidney diseases). As per recent statistics, globally 1.2 billion individuals have HTN. Majority of hypertensive cases are from low-and- middle income countries due to lack of awareness, limited access for treatment etc. [1] Under the definition set by the American College of Cardiology/American Heart Association (ACC/AHA), clinical HTN is defined as having a systolic blood pressure (SBP) of ≥ 130 mmHg and diastolic blood pressure (DBP) of ≥ 80 mmHg. [2] People remain hypertensive even in the presence of effective pharmacological treatment and the common concerns is adherence, side effects and the need for lifelong medication. Even smallest decreases in blood pressure are associated with a low cardiovascular mortality and morbidity risk.

The World health organisation (WHO), Joint National Committee New Guidelines (JNC 8) and the ACC/AHA recommend non-pharmacological approaches in prehypertensive stage. [3-5]. This includes dietary modifications such as decreased sodium intake, consistent exercise, maintaining healthy weight and sufficient intake of fruits and vegetables, along with moderate alcohol consumption and stress reduction practices. However, these guidelines rely on mind body practices while excluding certain therapies and formal practices which are not included in standard practice guidelines. There is clear absence of yoga practices as a central intervention in the management of HTN which

highlight the urgent need for the comprehensive coverage and clinical assessment of *yoga* based HTN management.

Yoga offers holistic healing for physical and mental wellbeing. Classical literature like *Hathayoga Pradipika* emphasizes *pranayama*, the mindful regulation of breath to stabilize the mind, balance the *dosha* and strengthen *Prana* (vital energy). [6,7] Evidence suggests that *pranayama* practices are known to regulate autonomic nervous system, by enhancing parasympathetic activity and reducing sympathetic drive and lowering stress responsiveness.

These mechanisms play an important role in blood pressure regulation thereby considering *pranayama* as a useful non-pharmacological strategy in HTN management. [8, 9]

Previous meta-analyses and reviews about yoga and HTN indicate that yoga may decrease SBP and DBP to a moderate degree. [10-12] Most reviews did not examine *pranayama* alone, instead they combined with asana, meditation and relaxation. As a result, the interventions were mixed, making it difficult to clearly identify the action of *pranayama* alone. Hence, the attempt has made to assess the effectiveness of *pranayama* in HTN. Also, since the most evidence were scattered, this review help to develop a framework for future research and practice guidelines. To overcome this, the scoping review methodology was conducted as it allows the mapping of available literature, while exploring underlying mechanism in a field where research is still emerging. [12] In order to maintain transparency as well as reproducibility without losing rigor, the review will

adhere to the PRISMA Extension for Scoping Reviews (PRISMA-ScR). [13, 14]

Hence, this scoping review aimed to locate, and map randomized controlled trials (RCTs) that examine the impacts of *pranayama* practices on blood pressure in hypertensive individuals. In particular, the review answered the following research question: What is the current level, nature and quality of RCT-based evidence related to *pranayama* interventions in systolic and diastolic levels of blood pressure? To guide Ayurveda practitioners, integrative clinicians and future researchers about the design and implementation of *pranayama*-based interventions in HTN, this review will summarize high-quality clinical evidence using an inclusion criterion of only RCTs published in PubMed, Scopus and Cochrane central to generate synthesis, based on highest level of clinical evidence. This review synthesis exclusively focuses on RCTs published on major databases to provide holistic views and guide Ayurveda professionals, integrative clinicians and researchers to design and implement *pranayama*-based intervention in managing HTN.

2. METHODOLOGY

2.1 Protocol and Registration

The scoping review has been carried out based on the extension of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses to Scoping Reviews (PRISMA-ScR) guidelines. [14] No formal protocol for this scoping review was prospectively

registered on Prospective Register of Systematic Reviews and Outcomes (PROSPERO), Open Science Framework (OSF) or any other registry. All methodological steps were predefined in internal review plan prepared by the study team and were strictly followed throughout the review process. The plan specified the objectives, eligibility criteria, search strategy, screening process and data-charting fields

2.2 Literature Search Strategy

The search was performed in the electronic databases PubMed, Scopus and Cochrane Central (CENTRAL) to find articles published since inception until June 2025. The search keywords were “*Pranayama*” OR “*Yogic Breathing*” OR “*Breathing Exercises*” AND “*Hypertension*” OR “*High Blood Pressure*” and they were searched using the filters restricted to randomized controlled trials (RCTs). For all database, different search strategies were used. In PubMed, search was conducted using MeSH terms and all Fields. In Scopus, the search was conducted in Titles-ABS-KEY fields and limited to the medical subject area and article type. In CENTRAL, search was conducted in titles, abstracts and keywords using the search filter trials (table 1). Two reviewers screened all titles and abstracts and reassessed potentially eligible full texts in relation to the inclusion criteria. The inclusion or exclusion of studies or duplication of records was resolved by agreement and arbitration by the respective authors where necessary.

Table 1: Search Strategy Used for Identifying Relevant Literature

Database	Search Terms Used	Filters Applied	Total Results Retrieved	Notes
PubMed	("Pranayama" OR "Yogic Breathing" OR "Breathing Exercises") AND ("Hypertension" OR "High Blood Pressure")	RCT filter applied; MeSH terms combined with All Fields; Language: English	72	Search customized using MeSH terms and All Fields
Scopus	("Pranayama" OR "Yogic Breathing" OR "Breathing Exercises") AND ("Hypertension" OR "High Blood Pressure")	Restricted to TITLE-ABS-KEY; limited to <i>Medical subject area</i> ; article type = RCT; Language: English	553	Search tailored to Scopus indexing fields
CENTRAL (Cochrane)	("Pranayama" OR "Yogic Breathing" OR "Breathing Exercises") AND ("Hypertension" OR "High Blood Pressure")	Trials filter applied; Language: English	128	Search conducted in titles, abstracts and keywords

2.3 Eligibility Criteria

The Population-Concept-Context (PCA) framework suggested by Joanna Briggs Institute (JBI) [14] was used to define the eligibility criteria. The patients were hypertensive or high blood pressure patients. The concept was interventions which is in the form of *pranayama* or yogic breathing exercises. The environment encompassed both clinical and community-based environments and geographical distribution.

In order to achieve methodological rigor, we decided to include only randomized controlled trials. The studies selected for inclusion needed to: (i) focus on *pranayama* or yogic breathing as the main intervention, (ii) HTN diagnosed patients, (iii) Published in the English language, (iv) indexed in PubMed, Scopus or Cochrane Central and (v) Quantifiable blood pressure readings (systolic and/or diastolic).

Exclusion criteria consisted of: Systematic reviews, meta-analysis and other types of case reports or case series, observational or non-randomized studies, trials in which *pranayama* was not primary intervention and trials where blood pressure was not outcome, redundant studies and studies lacking sufficient extractable information.

2.4 Data Extraction

Data extraction of included studies was charted using predefined data extraction sheet which was developed by the study team. Data of included studies was charted by two reviewers independently. Any disparities were resolved through discussion by ensuring accuracy and consistency. The variables were obtained as (i) Study identifiers (author, year, country), (ii) Sample size and participants characteristics, (iii) Type of *pranayama* used, (iv) Frequency, session time and total period of intervention, (v) Control or comparator group, (vi)

Primary outcomes (systolic and diastolic blood pressure with p-values) and (vii) Key findings/Notes.

2.5 Assumptions regarding missing data

In studies where there was lack of data regarding full outcome information (like p value or subgroup results), the data was used as reported by author and assumptions indicated in extraction table. Missing values were not being imputed. In case of the delivery of only graphic representations of the outcomes, approximate values were brought out by the interpretation of figures with a recognition of the limitation.

2.6 Data Synthesis

Because of the heterogeneity of *pranayama* methods, synthesis of data was done using length of interventions, frequency and the report of outcomes. Results were synthesized by classifying the included literature with respect to intervention given, comparator, duration, sample and outcomes. Consistent trends of influence on both systolic and diastolic blood pressure were noted. Factors or consideration like feasibility, adherence and current gap were noted as important factors to guide or shape future research direction.

2.7 Critical Appraisal

No formal critical appraisal or risk of bias assessment was carried out in this scoping review as primary goal was to map the extent, range and nature of available evidences (RCT's) rather than to evaluate quality or risk of bias of individual studies in line with PRISMA-ScR guidance. Hence critical appraisal was considered beyond scope of this scoping review. During synthesis

of study design, reporting and sample size were consider at that time.

3. RESULTS

3.1 Search Results

Using the electronic databases which includes PubMed, Scopus and Cochrane Central, a total of 753 records were found (PubMed 72, Scopus 553, Cochrane central 128). After initial screening, 16 studies found relevant to the aim of the review (9 in PubMed, 6 in Scopus, 1 in Cochrane Central). From the results, 3 duplicates studies were found, and 13 records were retrieved for screening based on titles and abstracts, among them 1 was filtered out because of availability of only abstract. After stepwise screening, 12 articles were reviewed for eligibility. As per the selection process, 6 articles were excluded seeking reason as non-relevant to topic or non-randomised and 6 articles were passed the inclusion criteria and were included for this scoping review. Detail PRISMA-ScR workflow illustrated in figure 1.

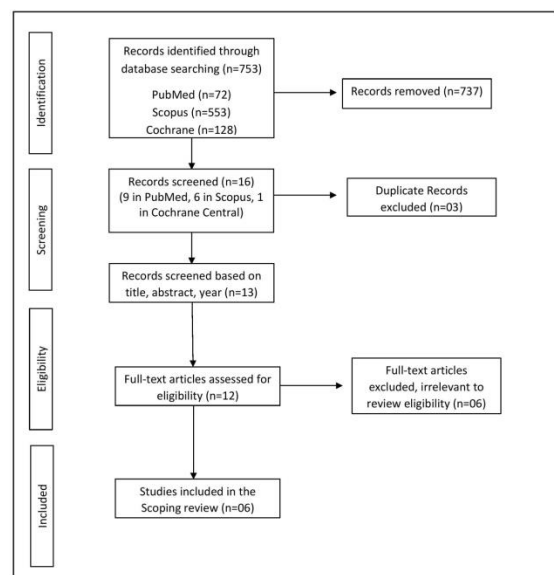


Figure 1: PRISMA-ScR flow chart.

3.2 Characteristics of Included Studies

Among studies included in this review, all were published between 2018-2024. The major interventions were *Sheetali*, *Sheetkari*, *Bhramari*, *Nadi Shodhana* and Yogic breathing exercises [15-20] for 10-20 minutes of interventions typically for a period of over four weeks with one study recording the immediate outcome following a single session. [18]

Studies with control group were diverse, not all control interventions were equal, including 2 having usual care, [15, 19] while other two have no intervention controls,

[16,20] and one as comparative pranayama practices. [3] One study examined the acute effects of one *Bhramari* session versus rest/breath awareness [4] and the other studies assessed long-term practice (one-three month). Measures were most often reported in research as SBP and DBP, and mean decreases were not reported. It is also noticed that all the studies were carried out in India clearly indicating cultural specificity. Study characteristics and outcomes were summarized in table 2.

Table 2: Summary of studies included in review

Sr. No.	Study	Pranayama type	Pranayama Frequency	Pranayama Duration per day	Sample Size	Control / Comparator	Study Duration
1	Thanalakshmi J. et al., 2020 [15]	<i>Sheetali Pranayama</i>	20 rounds daily	30 minutes	100 (50+50)	Control (No <i>Pranayama</i>)	3 month
2	Shetty p. et al., 2017 [16]	<i>Sheetali + Sheetkari Pranayama</i>	Daily	10 minutes each <i>pranayama</i>	60 (30+30)	Control (no <i>pranayama</i>)	1 month
3	Upadhyay J. et al., 2023 [17]	<i>Nadi Shodhana vs Bhramari Pranayama</i>	Daily	20 minutes	100 (50+50)	Active comparator (<i>Bhramari / Nadi Shodhana</i>)	Immediate + 6 weeks
4	Ghati N. et al., 2021 [18]	<i>Bhramari</i> (Bee-Humming) <i>Pranayama</i>	Single Session	05 minutes	70 (35+35)	Placebo slow breathing exercise	Single session
5	Raghiga DS. et al., 2024 [19]	<i>Sheetali with Kumbhaka Pranayama</i>	Daily (inhalation–retention–exhalation in a 1:2:2 ratio)	10 minutes	24 (12+12)	breath awareness	1 month
6	Mishra S. et al., 2018 [20]	Yogic Breathing	5 days per week	15 minutes	133	Control (no breathing exercises)	1 month

Table 3: Summary of Studies on *Pranayama* and Blood Pressure Outcomes with statistical tools used.

Sr. No.	Study	Study Design	<i>Pranayama</i> advised	BP Outcomes (SBP/DBP ± p-value)	Key Findings/Notes	Software and Statistical test used
1	Thanalakshmi J. et al., 2020 [15]	RCT (2 arm)	<i>Sheetali Pranayama</i>	BP ↓ (p < 0.05), (SBP ↓ p = 0.04, DBP ↓ p = 0.05)	Significant reduction in BP parameters, improved heart rate variability	Software: SPSS version 21 (IBM Corp., Armonk, NY, USA) Normality Test: Shapiro–Wilk test Within-group Comparison: Paired sample <i>t</i> -test Between-group Comparison: Independent <i>t</i> -test Significance Level: $p \leq 0.01$ considered statistically significant
2	Shetty p. et al., 2017 [16]	RCT (2 arm)	<i>Sheetali</i> and <i>Sheetkari Pranayama</i>	SBP ↓ 16.2 mmHg ($P \leq 0.001$), DBP not reported	Notable SBP reduction	Software: SPSS version 21 (IBM Corp., Armonk, NY, USA) Tests for Normality: Shapiro–Wilk test Within-group Comparison: Paired sample <i>t</i> -test Between-group Comparison: Independent two-sided <i>t</i> -test Significance Level: $P \leq 0.01$ (considered statistically significant for within-group changes)
3	Upadhyay J. et al., 2023 [17]	RCT (2 arm)	<i>Nadi Shodhana</i> against <i>Bhramari Pranayama</i>	<i>Nadi Shodhana</i> (SBP ↓ p = 0.01, DBP ↓ p = 0.02), <i>Bhramari</i> (SBP ↓ p = 0.011, DBP ↓ p = 0.04),	Both <i>Pranayama</i> show significant SBP & DBP decrease, improved HRV	Software: Scikit-learn package in Python Test for Normality: Shapiro–Wilk test Statistical Tests Used: • Wilcoxon rank-sum test • Mann–Whitney U test Significance Level: $P < 0.05$ (95% Confidence Interval)
4	Ghati N. et al., 2021	RCT (2 arm)	<i>Bhramari</i> (Bee-Humming)	SBP ↓ p = 0.77, DBP p =	single session of BHB exercise in does not	Software: SPSS version 21 (IBM Corp., Armonk, NY, USA)

	[18]		<i>Pranayama</i>	0.68	significantly reduce BP but significantly enhances parasympathetic tone (HRV)	<p>Normality Test: Shapiro–Wilk test</p> <p>Within-group Comparison: Paired <i>t</i>-test</p> <p>Between-group Comparison: Independent <i>t</i>-test</p> <p>Significance Level: $P \leq 0.05$ considered statistically significant</p>
5	Raghiga DS. et al., 2024 [19]	RCT (2 arm)	<i>Sheetali</i> with <i>Kumbhaka Pranayama</i>	SBP ↓ ($p < 0.049$), DBP ↓ ($p < 0.020$)	<i>Sheetali</i> pranayama and <i>Kumbhaka</i> lowers BP without cerebrovascular changes.	<p>Software: SPSS version 16.0 (IBM Corp., Armonk, NY, USA)</p> <p>Normality Test: Kolmogorov–Smirnov test</p> <p>Between-group Tests: Independent samples <i>t</i>-test (normal data), Mann–Whitney U test (non-normal data)</p> <p>Adjustment for Baseline Differences: ANCOVA with Bonferroni post-hoc test</p> <p>Within-group Tests: Paired samples <i>t</i>-test (normal data), Wilcoxon signed-rank test (non-normal data)</p> <p>Significance Level: $p < 0.05$</p>
6	Mishra S. et al., 2018 [20]	RCT (3 arm)	Yogic Breathing (Bellow breathing, Rapid Exhalation, Alternate nostril breathing and bumblebee breathing)	SBP ↓ ≥ 5 mm Hg systolic BP reduction (OR 4.49, 95% CI 1.18–17.0)	Reduction in SBP; parasympathetic activation	<p>Software: SPSS version 21 (IBM Corp., Armonk, NY, USA)</p> <p>Test for Normality: Shapiro–Wilk test</p> <p>Within-group Analysis: Paired sample <i>t</i>-test</p> <p>Between-group Analysis: Independent two-sided <i>t</i>-test (for pre- and post-intervention change)</p> <p>Significance Threshold: $p \leq 0.01$ considered statistically significant for within-group changes</p>

3.3 Results of included studies

Included studies shown positive outcome after interventions of *pranayama*; however, the magnitude

of the changes and the level of significance were different in studies. Out of them, 5 studies had 4 to 12 week interventions and 1 trial compared the short-term

effect of one-time interventions. *Sheetali pranayama* had shown positive outcome on SBP and DBP ($p < 0.04$ and $p < 0.05$ respectively) by reducing blood pressure over 12 weeks intervention which considered as significant. Similarly in another study on *Sheetali* and *Sheetakari* pranayama showed decrease in SBP by 16.2 mmHg ($P \leq 0.01$), however they did not claim about DBP change. In another study where, *Nadi Shodhana Pranayama* were tested against *Bhramari Pranayama*, where both stated significant drop (Nadi Shodhana SBP $p=0.01$, DBP $p=0.02$), *Bhramari* (SBP $p=0.011$, DBP $p=0.04$) respectively. Only single study that examined changes in blood pressure through *Bhramari pranayama* after one session does not reported a significant decrease in the SBP and DBP immediately (SBP \downarrow $p = 0.77$, DBP $p = 0.68$). Like other studies, *Sheetali pranayama* and *Kumbhaka* resulted in reduction of SBP ($p < 0.049$), DBP ($p < 0.020$) over period of 4 weeks intervention compared to breath awareness. Another study evaluated the impact of *yogic* breathing sessions as an indicator of parasympathetic effect showed reduction in SBP ≥ 5 mm Hg. These findings indicates that practicing pranayama daily for 10-20 mins. can effectively reduce blood pressure in both short term and long-term duration.

3.4 Summary of Charting Results

In short, the suggested results of screened six RCT's indicated that the reported *pranayama* modalities are associated with decrease in the SBP and DBP in hypertensive population [15-20]. Cooling *pranayamas* (*Sheetali*, *Sheetkari*) and the calm breathing *pranayamas* (*Bhramari*, *Nadi Shodhana*, *yogic* breath

awareness) have been linked to the reduction of blood pressure.

Out of this, all the trails reported effect on blood pressure (5 trails with effect after 4-12 weeks and 1 with immediate effect). The most common followed timing was 10-20 minutes per day, stating meaningful result. Even though the methods used were varied, still evidences to believe that *pranayama* intervention will be feasible and realistic in hypertensive subjects and can have a greater role in the cardiovascular reactivity. The limitations are limited number of studies, small sample size, shorter time interval and also study limited to Indian setting. Given these limitations, adequately powered multicentric RCT's with long follow ups can confirm the antihypertensive effect of *pranayama*.

3.5 Results Glance

In current scoping review, 6 RCT's that met with the eligibility criteria, evaluated the efficacy of *pranayama* practice for hypertension. All the studies included in review was carried out in India between period 2018-2024. Among them most followed pranayama practices were *Sheetalai*, *Sheetakari*, *Bhramari*, *Nadi Shodhana* and *Yogic* breathing for average of 10-20 mins daily over a period of 4-12 weeks. In that, most studies reported significant outcomes over a period of one month. The results are also indicative that *pranayama* may be used in acute term with potential antihypertensive results, but they also specify the evidence gaps in the literature because of small sample size, short term trials and lack of coverage of study location.

4. DISCUSSION

This review was carried out with the purpose of mapping all the available evidence (RCT's) based on impact of *pranayama* on HTN through major database to generate dependable findings. After thorough search, we found 6 studies which fulfilled inclusion criteria. All studies showed drop in blood pressure. Among selected studies for review, though there is no homogeneity in terms of type of pranayama selected, time duration of interval and diverse sample sizes, but the endpoint assessment was concentrated on reduction in blood pressure. Hence, this review aimed to map gaps in current available literature thereby giving future research directions. Apart from this, this review can act as guidance for clinicians and public regarding evidence-based *pranayama* modalities for hypertension.

Comparative discussion on the factors and parameters for the included studies (current available evidences):

In 06 RCTs, *Sheetali*, *Sheetkari*, *Bhramari*, *Nadi Shodhana* and Yogic Breathing were performed for 10–30 minutes a day for 4–12 weeks. In these trials, all showed statistically significant reductions in SBP and DBP and found to be effective in lowering BP.

4.1 Type and Duration of *Pranayama*: Cooling Pranayamas (*Sheetali*, *Sheetkari*) and calming pranayama (*Bhramari*, *Nadi Shodhana*) have shown consistent BP reductions when practised regularly over a period of at least four weeks. [15,16] Short-term effects or single sessions [18] resulted in improvement of the parasympathetic tone but not significant BP reduction, in support of published data that a longer duration was required for vascular effects. [21]

4.2 Frequencies and Design: All studies practised daily with two-arm randomised controlled single blind trial except one study had three-arm with three-arm trial. [20] It has been stated that yogic breathing improves autonomic balance but there is a need of larger, multicentric studies. [22]

4.3 Sample Size: Studies included in this review had sample sized ranging from minimum being 24 and maximum being 133. The largest sample size showed a reduction in SBP by ≥ 5 mm Hg, [20] however similar results were seen in smaller sample sized studies (which were insignificant).[19] However studies such as other RCT (both parallel and cross over design) did show a significant decrease in BP, the significance of results/similar results in these single-centre smaller sample-sized studies has limitations that prevent generalisability.

4.4 Results and statistical tools: Overall average reductions in blood pressure were 8 to 16 mmHg (SBP) and 4 to 10 mmHg (DBP), suggesting effect sizes comparable with mild drug therapy. SPSS versions used in individual studies were 16–21 or Python's Scikit-learn version. All the studies employed the Shapiro–Wilk, t test, Mann–Whitney U, ANCOVA and hence was consistent.

4.5 Interpretation: There is evidence that, on the whole, 10–20 min of *pranayama* practice per day for 4–6 weeks is effective in decreasing Blood Pressure via parasympathetic stimulation and stress control [23,24]. That being said, additional robust large-scale trials should be performed to ascertain the long-term therapeutic effects of *pranayama* on blood pressure.

Literature review published had shown anti-hypertensive effects of *yoga* and other mind-body intervention. Data on systematic review and meta-analysis showed moderate effects of *yoga*-based interventions on blood pressure [25,26], but most of them are combined with *asanas*, meditation and lifestyle modification, hence it is hard to separate the *pranayama* effect. This review identifies the impact of *pranayama* practices on blood pressure by paying attention to RCT's of *pranayama*. Effectiveness was seen through changes in SBP (varying between 8-16 mmHg) in trials. [15-20] This also can be compared with first line antihypertensive medicines [27] ultimately benefiting both clinician and patient clinically.

In Ayurveda, these outcomes are relevant to the disciplined practice of classical *pranayama* as a controller of *prana vayu*, and literate practice of *pranayama* as a training of mind and regarded as a regulator of *prana vata*. The drop in blood pressure can be attributed to the impact on *vata dosha*, calming nervous system and healing of the flow of the life force. For Ayurveda healers, this study provides a scientific basis for ancient practices and guide in advocacy of specific *pranayama* techniques (like *Sheetali*, *Bhramari*, *Nadi Shodhana*) which shows objective clinical effects. [15-17,19] The evidence can suggest to the biomedical researchers that *pranayama* can prove to be a non-expensive, safe adjuvant to lifestyle changes and drug therapy, particularly for patients with mild to moderate HTN and it can be a part of integrative practices.

This review has many unique features, based on available literature it was the first scoping review

exclusively dealing with only RCT's aimed to gain reliable findings. Secondly, this highlights common *pranayama* technique for minimum duration. Also, it gives priority to both short term and long-term goals [28] Clinicians offering advice to patients need to know about this twofold observation when the patient lacks the motivation to make changes over time.

Meanwhile there are some limitations in reviewed studies. First, no formal critical appraisal was performed of included studies, therefore limitation in methodological quality and risk of bias cannot be accounted for. Second limitation was inclusion of only RCT's, which may excluded other relevant study designs. Third restriction to English language articles which may have introduced language bias. Apart from this others include small sample size (30-100 people). Interventions were of short duration with maximum intervention of being six weeks, so the long-term effect of *pranayama* remains unclear. In addition to this, all the trials were conducted in India, reflecting strong cultural background and raising question about generalisability among global population thereby giving future direction for multi-centric studies. All the trials reported showed better outcomes in terms of medication or dose reduction, fewer cardiovascular events and improved quality of life. We did not conduct detailed quality or bias assessment as this was a scoping review which limits deeper evaluation of the evidence. Despite of all these limitations, outcomes were promising indicating that *pranayama* is a safe, effective and easy technique in lowering HTN. This states that *Pranayama* can be adopted in the treatment strategy

among hypertensive individuals. Additionally, it provides guidance to Integrative practitioners and public to choose *pranayama* technique in clinical and self-care settings.

Evidence Gap: First and important lacunae lies in limited number of RCT's, among them most of the studies were with small sample size and short intervention or follow up period with commonly of being 4 weeks. Additionally, all the included trials were conducted in India keeping lacunae in global universality. Apart from this, poorly defined protocols contribute to lack of long-term data and minimum attention towards adherence and other aspects of patient monitoring add to the limitations. Addition to this, lack of comparison or standard comparator keep hole in the evidence. So, overall lacunae lie in a smaller number of RCT's, and heterogeneity, small sample sizes, short study period or long term follow ups, poorly defined protocol, methodological weaknesses like lack of blinding and monitoring of adherence and other aspects of patients. These gaps open the doors for future studies.

Future Direction: Future studies should be focused on overcoming these limitations by conducting large scale, multi centre RCT's with long term follow up and assessment at global level to ensure broader applicability and sustainability. Methodology can be improved by conducting proper randomization, blinding, standard comparator with more standard and clearly defined protocols. More importance can be given on monitoring adherence and compliance. Though, comparative studies with conventional care

can clarify relative efficacy. By filling the above mentioned gaps, future research can provide with more reliable outcomes and clearer guidance for clinical practice.

5. CONCLUSION

We searched RCTs of *pranayama* as an intervention for HTN treatment. The search was conducted in the PubMed, Scopus and Cochrane Central databases. Trials were scant and the evidence for the body of trials was limited but emerging. Even though, studies found were limited in number, reports suggest the positive and promising outcomes in HTN. Major strength of this review is that it included only RCT's from major databases to generate more dependable evidence. By combining these findings, this review gives clear guidance to Integrative clinician as well public with evidence based practicable *pranayama's* in the management of hypertension. It has additional benefits as it is easy to perform and devoid of adverse events. At the same time, this review highlights lacunae in current evidence like lack of generalisability, heterogeneous designs, small sample sizes, single centric studies and short-term assessment trials.

To address this gap, there is a need for further large scale RCT's with longer follow ups. Multicentric studies will gain a higher level of evidence for *pranayama* in blood pressure management.

Practical and Clinical Practice Application: Depending on finding of studies included, it can be stated that *pranayama* such as *Sheetali*, *Bhramari*, *Sheetakari*, *Nadi Shodhan* and *yogic* breathing practice will be easy, safe and cost-effective technique and can be adopted in the

strategy in HTN. These studies show that *pranayama* (10-20 minutes daily) practice over 4-6 weeks is having substantial effect on blood pressure in hypertensive individuals.

List of Abbreviations:

HTN: Hypertension;
RCT(s): Randomized Controlled Trial(s);
SBP: Systolic Blood Pressure;
DBP: Diastolic Blood Pressure;
ACC/AHA: American College of Cardiology/American Heart Association;
WHO: World Health Organization;
JNC 8: Eighth Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure;
PRISMA-ScR: PRISMA Extension for Scoping Reviews;
PCA: Population–Concept–Context Framework;
JBI: Joanna Briggs Institute;
PROSPERO: Prospective Register of Systematic Reviews and Outcomes;
CENTRAL: Cochrane Central Register of Controlled Trials;
BP: Blood Pressure;
CI: Confidence Interval;
ANCOVA: Analysis of Covariance;
SPSS: Statistical Package for the Social Sciences;
HRV: Heart Rate Variability;
BHB: Bee-Humming Breathing.

Authors Details:

¹PG Scholar. Department of Kayachikitsa, KLE Academy of Higher Education and Research, Deemed to be University, Shri BMK Ayurveda Mahavidyalaya, Shahpur, Belagavi, Karnataka, India-590003

^{2*} Associate Professor, Department of Kayachikitsa, KLE Academy of Higher Education and Research, Deemed to be University, Shri BMK Ayurveda Mahavidyalaya, Shahpur, Belagavi, Karnataka, India-590003

³PG Scholar. Department of Kayachikitsa, KLE Academy of Higher Education and Research, Deemed to be University, Shri BMK Ayurveda Mahavidyalaya, Shahpur, Belagavi, Karnataka, India-590003

⁴PG Scholar. Department of Swasthavritta and Yoga, KLE Academy of Higher Education and Research, Deemed to be University, Shri BMK Ayurveda Mahavidyalaya, Shahpur, Belagavi, Karnataka, India-590003

⁵PG Scholar. Department of Kayachikitsa, KLE Academy of Higher Education and Research, Deemed to be University, Shri BMK Ayurveda Mahavidyalaya, Shahpur, Belagavi, Karnataka, India-590003

⁶PG Scholar. Department of Kayachikitsa, Shiva trust's Yashwantrao Chavan Ayurvedic Medical College and Hospital, Chh. Sambhajinagar, Maharashtra, India- 431007

Authors Contribution:

Conceptualisation and data Management: SK, BP
Data Collection and literature search: SK, BP, AP
Writing -Original Draft: SK, BP, DS, AS
Proofreading/Copyediting: SK, BP, PP
Approval of final manuscript: All authors

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REFERENCES:

1. World Health Organization [Internet]. Hypertension. Geneva: WHO; 2023 [cited 2025 Sep 29]. Available from: <https://www.who.int/news-room/fact-sheets/detail/hypertension>
2. Whelton PK, Carey RM, Aronow WS, Casey DE, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults. J Am Coll Cardiol.

- 2018 May;71(19):e127–248. Available from: <https://pubmed.ncbi.nlm.nih.gov/29146535>
3. World Health Organization [Internet]. Guideline for the pharmacological and non-pharmacological treatment of hypertension in adults. Geneva: WHO; 2021 [cited 2025 Sep 29]. Available from: <https://www.who.int/publications/i/item/9789240033986>
4. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *JAMA*. 2014 Feb;311(5):507–520. Available from: <https://pubmed.ncbi.nlm.nih.gov/24352797>
5. Whelton PK, Carey RM. The 2017 clinical practice guideline for high blood pressure. *JAMA*. 2017 Dec;318(21):2073–2074. Available from: <https://pubmed.ncbi.nlm.nih.gov/29159453>
6. Paramhansa Swami Ananta Bharati. *Hathayogapradeepika, Upadesha 2, verse no. 2*. Original first edition, Varanasi; Chaukhambha Orientalia; 2018; 37.
7. Choudhary K. Hypertension and its management through Panchakarma. *Journal of Ayurveda and Holistic Medicine (JAHM)*. 2021 Mar;3(3). Available from: <https://doi.org/10.70066/jahm.v3i3.252>
8. Jerath R, Edry JW, Barnes VA, Jerath V. Physiology of long pranayamic breathing: neural respiratory elements may provide a mechanism that explains how slow deep breathing shifts the autonomic nervous system. *Med Hypotheses*. 2006;67(3):566–71. Available from: <https://pubmed.ncbi.nlm.nih.gov/16624497>
9. Sapkota S, Devkota D, Ramadevi C. Yoga – sanative to Urdhwajatrugata Vyadhis. *Journal of Ayurveda and Holistic Medicine (JAHM)*. 2024 Jul;12(7). Available from: <https://doi.org/10.70066/jahm.v12i7.1429>
10. Tyagi A, Cohen M. Yoga and hypertension: a systematic review. *Altern Ther Health Med*. 2014 Mar–Apr;20(2):32–59. Available from: <https://pubmed.ncbi.nlm.nih.gov/24657958/>
11. Ahuja N, Bhardwaj P, Pathania M, Sethi D, Kumar A, Parchani A, Chandel A, Phadke A. Yoga Nidra for hypertension: a systematic review and meta-analysis. *J Ayurveda Integr Med*. 2024 Mar–Apr;15(2):100882. Available from: <https://doi.org/10.1016/j.jaim.2023.100882>
12. Munn Z, Peters MDJ, Stern C, Tufanaru C, McArthur A, Aromataris E. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Med Res Methodol*. 2018 Nov;18:143. Available from: <https://pubmed.ncbi.nlm.nih.gov/30453902>
13. Tricco AC, Lillie E, Zarin W, O’Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med*. 2018 Oct;169(7):467–73. Available from: <https://pubmed.ncbi.nlm.nih.gov/30178033>
14. Archibald D, Patterson R, Haraldsdottir E, Hazelwood M, Fife S, Murray SA. Mapping the progress and impacts of public health approaches to palliative care: a scoping review protocol. *BMJ Open*. 2016 Jul;6(7):e012058. Available from: <https://doi.org/10.1136/bmjopen-2016-012058>
15. Thanalakshmi J, Maheshkumar K, Kannan R, Sundareswaran L, Venugopal V, Poonguzhali S. Effect of Sheetalī pranayama on cardiac autonomic function among patients with primary hypertension: A randomized controlled trial. *Complement Ther Clin Pract*. 2020 May;39:101138. Available from: <https://doi.org/10.1016/j.ctcp.2020.101138>
16. Shetty P, Reddy BKK, Lakshmeesha DR, Shetty SP, Kumar GS, Bradley R. Effects of Sheetalī and Sheetkari pranayamas on blood pressure and autonomic function in hypertensive patients. *Integr Med (Encinitas)*. 2017;16(5):32–7. Available from: <https://pubmed.ncbi.nlm.nih.gov/30936803>
17. Upadhyay J, Nandish NS, Shivaprasad K. Effects of Nadishodhana and Bhramari pranayama on heart rate variability, auditory reaction time, and blood pressure: a randomized clinical trial in hypertensive patients. *Int J Yoga*. 2023 Apr–Jun;16(2):120–8. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC10388195/>
18. Ghati N, Killa AK, Sharma G, Karunakaran B, Agarwal A, Mohanty S, et al. A randomized trial of the immediate effect of Bee-Humming Breathing exercise on blood pressure and heart rate variability in patients with essential hypertension. *Explore*

- (NY). 2021 Jul-Aug;17(4):312–19. Available from: <https://doi.org/10.1016/j.explore.2020.03.009>
19. Radhiga DS, Mooventhan A, Sangavi SA, Nivethitha L, Venkateswaran ST. Impact of Sheetal Pranayama with Kumbhaka on blood pressure and cerebrovascular hemodynamics in patients with hypertension: A pilot randomized controlled trial. *Brain Behav Immun Health*. 2024;7:100078. Available from: <https://doi.org/10.1016/j.bbii.2024.100078>
20. Misra S, Smith J, Wareg N, Hodges K, Gandhi M, McElroy JA, et al. Take a deep breath: A randomized control trial of Pranayama breathing on uncontrolled hypertension. *Adv Integr Med*. 2019 May;6(2):66–72. Available from: <https://doi.org/10.1016/j.aimed.2018.08.002>
21. Jerath R, Edry JW, Barnes VA, Jerath V. Physiology of long pranayamic breathing: Neural respiratory elements may provide a mechanism that explains how slow deep breathing shifts the autonomic nervous system. *Medical Hypotheses*. 2006 Sep;67(3):566–571. Available from: <https://doi.org/10.1016/j.mehy.2006.02.042>
22. Tyagi A, Cohen M. Yoga and hypertension: A systematic review. *Alternative Therapies in Health and Medicine*. 2014 Mar–Apr;20(2):32–59. Available from: <https://pubmed.ncbi.nlm.nih.gov/24657958>
23. Saoji AA, Raghavendra BR, Manjunath NK. Effects of yogic breath regulation: A narrative review of scientific evidence. *Journal of Ayurveda and Integrative Medicine*. 2019 Oct–Dec;10(4):250–258. Available from: <https://doi.org/10.1016/j.jaim.2017.07.008>
24. Pal GK, Velkumary S, Madanmohan. Effect of short-term practice of breathing exercises on autonomic functions in normal human volunteers. *Indian Journal of Medical Research*. 2004 Aug;120(2):115–121. Available from: <https://pubmed.ncbi.nlm.nih.gov/15347862>
25. Cramer H, Haller H, Lauche R, Dobos G. Yoga for hypertension: a systematic review and meta-analysis. *Am J Hypertens*. 2014 Sep;27(9):1146–51. Available from: <https://doi.org/10.1093/ajh/hpu078>
26. Hagins M, States R, Selfe T, Innes K. Effectiveness of yoga for hypertension: systematic review and meta-analysis. *Evid Based Complement Alternat Med*. 2013;2013:649836. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3679769/>
27. Nardoiani G, Pala B, Scoccia A, Volpe M, Barbato E, Tocci G. New drug strategies for treating resistant hypertension: the importance of a mechanistic, personalized approach. *High Blood Press Cardiovasc Prev*. 2024 Mar;31(2):99–112. Available from: <https://pubmed.ncbi.nlm.nih.gov/38616212>
28. Tricco AC, Lillie E, Zarin W, O’Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med*. 2018 Oct;169(7):467–73. Available from: <https://pubmed.ncbi.nlm.nih.gov/30178033>