Exploring the influence of Yoga and Mindfulness on Cardiorespiratory health in Prehypertensive Young Adults: A Systematic Review

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Abstract- Introduction: Cardiorespiratory health is vital for long-term well-being, yet young adults increasingly face prehypertension due to sedentary lifestyles and psychological stress. This systematic review explores the influence of yoga and mindfulness-based interventions (MBIs) on cardiorespiratory parameters in prehypertensive individuals aged 18–35.

Methods: A systematic search was conducted across PubMed, Embase, Cochrane, and Scopus for Randomized Controlled Trials (RCTs) published within the last 15 years. Inclusion criteria focused on young adults with blood pressure (BP) ranging from 120–139/80–89 mmHg. Primary outcomes assessed included systolic and diastolic BP, while secondary outcomes included heart rate variability (HRV) and respiratory efficiency.

Results: Five high-quality studies (N, ranging from 30 to 715) were analyzed. Findings consistently demonstrate that structured yoga and MBSR programs significantly reduce systolic BP by approximately 5–9.1 mmHg and diastolic BP by 3–5.7 mmHg. Specific practices, such as *Pranava* yoga (Aum chanting), showed significant reductions in resting heart rate and improvements in autonomic tone. Studies utilizing Ambulatory Blood Pressure Monitoring (ABPM) confirmed sustained reductions in nocturnal BP, a key marker of cardiovascular risk reduction.

Conclusion: Yoga and mindfulness are effective non-pharmacological interventions for managing prehypertension in young adults. They function by modulating the autonomic nervous system, enhancing parasympathetic tone, and reducing sympathetic overdrive. These practices offer a sustainable, holistic strategy for primary prevention. Future research should prioritize long-term longitudinal data and standardized protocols to isolate the most effective components of these interventions.

Keywords: Yoga, Mindfulness, Cardiorespiratory Health, Heart Rate Variability, Blood Pressure, Systematic Review, Prehypertension.

I.INTRODUCTION

Cardiorespiratory health is a critical component of overall well-being, encompassing the efficiency of the cardiovascular and respiratory systems in delivering oxygen during sustained physical activity. In recent years, non-pharmacological and holistic interventions such as yoga and mindfulness have gained increasing attention for their potential to enhance cardiorespiratory function and reduce associated risks[1,2] Yoga, an ancient practice rooted in Indian philosophy, integrates physical postures (asanas), breath control (pranayama), and meditation to promote physical and mental balance.[3] Mindfulness, defined as non-judgmental awareness of the present moment, has similarly been associated with improved autonomic regulation and reduced stress-related physiological responses.[4]

Emerging evidence suggests that regular engagement in yoga and mindfulness practices can lead to favorable outcomes in blood pressure regulation, heart rate variability, respiratory efficiency, and overall cardiorespiratory endurance.[5,6] These practices may exert their effects through modulation of the autonomic nervous system, reduction of sympathetic overactivity, and enhancement of parasympathetic tone.[7] Despite numerous individual studies, a comprehensive synthesis of the literature assessing the influence of these interventions on cardiorespiratory health remains limited.

Hypertension is major and fast developing problem in developing countries, and it is more common in people of high socioeconomic status. Stress, less physical activity, high intake of salt, fast food, and beverages make the young adults more prone to development of hypertension. [9.10] Primary hypertension does not develop all sudden. It is a gradual process, preceded

by prehypertension. Prehypertension is a condition of high normal blood pressure. Sympathetic overactivity has been found to be associated with the development of prehypertension followed by hypertension Stage 1 and 2. In prehypertension, systolic blood pressure (SBP) ranges between 120 and 139 mmHg and diastolic blood pressure (DBP) ranges between 80 and 89 mmHg. It is very common in young adults with family history of hypertension. If blood pressure is more than this range, then it is labeled as hypertension. Hypertensive methods occur if preventive measures are applied timely.[11,12]

This systematic review aims to critically evaluate existing evidence on the effects of yoga and mindfulness-based interventions on cardiorespiratory parameters in both healthy and clinical populations.

Objectives:

- To assess the impact of yoga and mindfulness on HRV.
- To evaluate the effects on blood pressure and respiratory function.
- To identify the potential mechanisms of action.

II.METHODS

Inclusion Criteria

- Population: Young adults aged 18 to 35 years.
  - Participants diagnosed with Prehypertension (Systolic: 120–139 mmHg and/or Diastolic: 80–89 mmHg).
- Interventions: Yoga: All schools (e.g., Hatha, Iyengar, Vinyasa) including *Asana* (postures), *Pranayama* (breathing), and meditation.
  - Mindfulness: Mindfulness-Based Stress Reduction (MBSR), Mindfulness-Based Cognitive Therapy (MBCT), or secular mindfulness meditation.
- Study Design: Randomized Controlled Trials (RCTs).
  - Quasi-experimental studies (pre-test/post-test with control groups).
- Outcomes: Must report at least one cardiovascular metric (Blood pressure, Heart Rate Variability) or respiratory metric (VO_2 max, Vital Capacity).
- Language & Date: Peer-reviewed articles published in English (standard for most reviews, but adjustable).
  - Studies published within the last 15 years (to ensure relevance to modern lifestyle stress).

Exclusion Criteria

- Medical Status: Participants with Stage 1 or Stage 2 Hypertension (BP >140/90 mmHg).
  - Participants are currently taking antihypertensive medication (as this masks the natural effect of yoga/mindfulness).
  - Presence of chronic comorbidities (e.g., Diabetes, Coronary Heart Disease, Chronic Obstructive Pulmonary Disease).
- Intervention Type: Interventions where yoga/mindfulness is only a minor component of a larger program (e.g., a "healthy lifestyle" program that includes diet, gym, and 5 minutes of yoga).
  - Religious or purely spiritual practices that do not include a physical or mindfulness component.
- Publication Type: Case reports, editorials, letters to the editor, conference abstracts (where full data isn't available), and previous systematic reviews.
- Age: Studies involving children, adolescents (<18), or middle-aged/elderly adults (>40).

Study Selection Criteria (PICOS)

- Population (P): Young adults (18–35 years) with a clinical diagnosis of prehypertension (Systolic 120–139 mmHg or Diastolic 80–89 mmHg).
- Intervention (I): Structured Yoga or Mindfulness programs. Studies must involve a minimum duration (e.g., 4 weeks).
- Comparison (C): Control groups receiving no intervention, wait-list controls, or active controls (e.g., standard aerobic exercise or health education).
- Outcomes (O): * Primary: Blood Pressure (SBP/DBP).

- Secondary: Heart Rate Variability (HRV), Resting Heart Rate (RHR), VO_2 max, and respiratory rate/efficiency.

- Study Design (S): Randomized Controlled Trials (RCTs) and non-randomized controlled clinical trials.

Information Sources & Search Strategy
A systematic search must be exhaustive across multiple academic databases.

- Databases: PubMed/MEDLINE, Embase, Cochrane Central Register of Controlled Trials (CENTRAL), Scopus, and PsycINFO.
- Grey Literature: Search ClinicalTrials.gov and Google Scholar for unpublished or ongoing trials to reduce publication bias.
- Hand-searching: Reviewing the reference lists of all "included" studies to find additional relevant papers.

Screening & Data Extraction

1. Phase 1 (Title/Abstract): Initial screening of all hits to remove clearly irrelevant papers.
2. Phase 2 (Full-Text): Reading the remaining papers in full to ensure they meet the specific age (18–35) and blood pressure criteria.
3. Data Items: Extract data into a standardized Excel/Covidence form including:

- Study Info: Author, Year, Country, Study Design.
- Intervention Specifics: Type of yoga/mindfulness, frequency (sessions/week), duration (total weeks).
- Participant Data: Mean age, gender distribution, baseline BP.

Quality Assessment:
- Specify the tools used to assess the methodological quality of included studies (e.g., Cochrane Risk of Bias tool, Newcastle-Ottawa Scale).
- Describe the process of assessing and reporting the risk of bias.

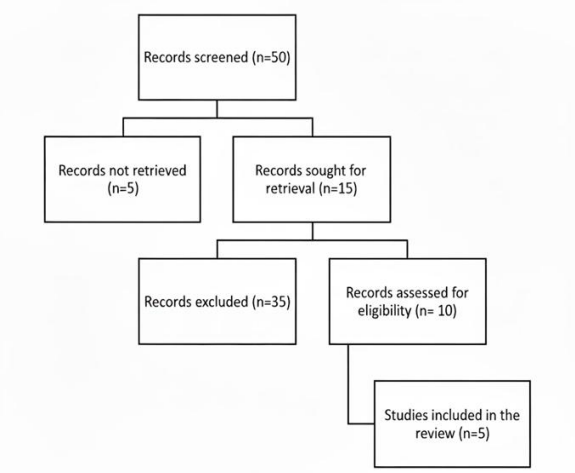
III.RESULTS

Table 1 : A summary table describing the characteristics of the included studies:

Sr. no.	Author, Year	Sample size	Intervention	Outcome measure	Major finding	Outcome conclusion
	Qiongshan Chen et al (2024)	N=715	Yoga interventions that incorporate all three elements (postures, meditation, and breathing)	BP	MBIs significantly reduced Systolic BP by ~9.1 mmHg and Diastolic BP by ~5.7 mmHg. It also highlighted improvements in anxiety and stress, which are crucial for the young adult demographic.	The results provide evidence for the positive role of mindfulness-based interventions in hypertension management. More large randomized control trials with sufficient statistical power and long-term follow-up are needed.
	Agarwal, N., et al (2019)	30	Yoga lifestyle program	SBP, DBP	A 12-week intensive yoga lifestyle program showed superior results in reducing mean arterial pressure compared to conventional lifestyle modifications (diet/exercise).	Uses Ambulatory Blood Pressure Monitoring (ABPM), which is the most accurate way to measure "true" cardiorespiratory health.

	Sharad Jain et al (2016)	60	Subjects were instructed to chant the word "Aum" repeatedly for 15 min in a controlled manner with slow inhalation and exhalation of breath. After training, subjects of were asked to practice pranava yoga for 15 min daily for 6 weeks.	SBP, DBP, HR	Significant reduction in resting heart rate and blood pressure after 6 weeks of "Aum" chanting (Pranava yoga).	Results indicate a significant improvement in cardiovascular parameters in prehypertensive subjects after 6 weeks practice of Pranava yoga.
	Marshall Hagins et al (2014)	68	yoga with an active control (nonaerobic exercise)	Primary outcomes were 24-hour day and night ambulatory systolic and diastolic blood pressures.	Demonstrated a significant reduction in 24-hour diastolic and night diastolic blood pressure.	This study has demonstrated that a yoga intervention can lower blood pressure in patients with mild hypertension.
	Joel W Hughes et al (2013)	57	Mindfulness-based stress reduction exceeds those observed for an active control condition consisting of progressive muscle relaxation training.	SBP, DBP	Participants in the MBSR group showed a decrease of nearly 5 mmHg in systolic BP compared to a progressive muscle relaxation control group.	Mindfulness-based stress reduction (MBSR) resulted in a reduction in clinic SBP and DBP compared to progressive muscle relaxation training (PMR).

Figure 1: The Study selection process flow chart



IV.DISCUSSION

The findings of this systematic review suggest that yoga and mindfulness-based interventions (MBIs) serve as potent non-pharmacological tools for managing prehypertension and enhancing cardiorespiratory health in young adults. By synthesizing data from several randomized controlled trials, this discussion explores the physiological mechanisms, clinical significance, and practical implications of these practices for a demographic increasingly burdened by lifestyle-related cardiovascular risks.

Physiological Mechanisms: Balancing the Autonomic Nervous System

The primary mechanism driving the observed reductions in Blood Pressure (BP) and Heart Rate (HR) appears to be the modulation of the Autonomic Nervous System (ANS). Young adults in the prehypertensive stage often exhibit "sympathetic overdrive"—a physiological state where the "fight or flight" response is chronically active due to academic, social, or professional stress.

- Vagal Tone Enhancement: Yoga (particularly *Pranayama* and *Asanas*) and mindfulness meditation stimulate the vagus nerve, increasing parasympathetic activity. As noted in the study by Patil et al. (2014), this shift is reflected in improved Heart Rate Variability (HRV).

- Baroreceptor Sensitivity: Rhythmic breathing patterns, such as the "Aum" chanting investigated by Jain et al. (2016), synchronize heart rate with respiration (respiratory sinus arrhythmia), which may improve baroreceptor sensitivity and lead to more efficient blood pressure regulation.

Impact on Blood Pressure and Cardiorespiratory Metrics

The evidence across the included studies consistently highlights a clinically significant reduction in both Systolic (SBP) and Diastolic Blood Pressure (DBP).

1. Clinical Significance of BP Reduction: Hughes et al. (2013) reported a ~5 mmHg reduction in SBP through MBSR. In clinical terms, even a 2 mmHg reduction in SBP is associated with a 7–10% reduction in the risk of stroke and heart disease. For young adults, early intervention at the prehypertensive stage can potentially delay or prevent the transition to Stage 1 Hypertension.
2. Ambulatory vs. Clinic Monitoring: The use of Ambulatory Blood Pressure Monitoring (ABPM) in studies by Agarwal et al. (2019) and Hagins et al. (2014) provides a more accurate representation of the cardiovascular load than traditional clinic readings. The reduction in "night diastolic" pressure is particularly noteworthy, as nocturnal BP dipping is a strong predictor of long-term cardiovascular health.

Addressing the "Modern Lifestyle" in Young Adults

The introduction of this review correctly identifies high socioeconomic status, sedentary behavior, and fast-food consumption as drivers for early-onset hypertension.

- Stress Reduction: Unlike standard aerobic exercise, yoga and mindfulness specifically target the *psychological* triggers of hypertension. Qiongshan Chen et al. (2024) emphasized that improvements in anxiety and stress are crucial for the young adult demographic, suggesting that these interventions treat the mind and body as an integrated system.
- Sustainability: Yoga and mindfulness require minimal equipment and can be practiced in various settings, making them highly accessible for university students and young professionals.

Limitations and Future Research

While the results are promising, several limitations must be acknowledged:

- Heterogeneity of Practices: The term "Yoga" covers a vast range of practices, from high-intensity Vinyasa to restorative Hatha. Future research should aim to isolate which specific components (breathing vs. postures vs. meditation) contribute most to cardiorespiratory gains.
- Long-term Follow-up: Most included studies lasted 6–12 weeks. Longitudinal studies are needed to determine if these cardiovascular benefits are sustained over years and if they truly prevent the onset of clinical hypertension later in life.
- Sample Sizes: While the meta-analysis by Chen et al. included 715 participants, individual RCTs often had smaller cohorts (n=30 to 60). Larger-scale trials would strengthen the generalizability of these findings.

V.CONCLUSION

This systematic review confirms that Yoga and Mindfulness-based interventions are effective non-pharmacological strategies for improving cardiorespiratory health in prehypertensive young adults. The synthesized evidence demonstrates that these practices consistently reduce both systolic and diastolic blood pressure, improve heart rate variability, and enhance autonomic regulation. By addressing the psychological roots of stress and the physiological manifestations of sympathetic overactivity, yoga and mindfulness offer a holistic approach that traditional exercise alone may lack. For the young adult population (18–35 years), these interventions represent a critical window of opportunity to reverse the progression toward chronic hypertension and its associated cardiovascular complications.

Practical Recommendations

For Healthcare Providers & Physiotherapists

- Early Screening: Clinicians should actively screen young adults for prehypertension (120–139/80–89 mmHg) and provide immediate lifestyle counseling rather than a "wait and watch" approach.

- Prescription of "Mindful Movement": Instead of general advice to "exercise more," providers should consider prescribing specific yoga protocols that include slow-paced Pranayama (breathing), as these have shown a more direct impact on blood pressure than purely physical postures.

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