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An Insight on the Therapeutic Potential of Breathing Exercises for Hypertension and Cardiovascular Health: Review of Current Evidence and Future Directions

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ABSTRACT
Hypertension, a key contributing factor for cardiovascular disease (CVD), continues to drive global morbidity and mortality, affecting over 1.3 billion people worldwide. While pharmacological treatments are the standard of care, they are often associated with side effects and do not always achieve optimal blood pressure control. In recent years, non-pharmacological interventions, particularly breathing exercises, have gained recognition for their potential to complement conventional therapies. This review explores the therapeutic impact of various breathing techniques including diaphragmatic deep breathing, 4-7-8 breathing, box breathing, alternate nostril breathing, and pursed-lip breathing on blood pressure regulation, cardiovascular health, and autonomic function. Additionally, we examine device-guided slow breathing as an emerging intervention. Despite robust evidence supporting the individual benefits of these techniques, there is a notable gap in the literature regarding the combined effects of multiple breathing exercises. To address this gap, our review underscores the importance of future research to explore the potential synergistic benefits of combining different breathing patterns in the management of hypertension and enhancing cardiovascular health.

Breathing exercise, Therapeutic potential, Hypertension, Cardiovascular diseases, Current evidence.

Keywords: Breathing exercise, Blood pressure, Hypertension

INTRODUCTION

Cardiovascular diseases are currently the leading cause of morbidity and mortality worldwide with more than half a billion people around the world affected by CVDs (World Heart Report, 2023; Ojo *et al*., 2024). According to the World Heart Federation, CVD accounted for 20.5 million deaths in the year 2021 which is closed to one-third of all deaths globally (WHR, 2023). Hypertension has remained as a key and primary contributing factor to CVDs with an estimated 1.3 billion people living with hypertension globally (Ojo *et al*., 2024). Almost two-third of these people are living in low- and middle-income countries**.** Hypertension therefore stands as a critical global health issue, significantly heightening the risk for cardiovascular diseases, stroke, and renal complications (Abdulrauf *et al*., 2025). In recent decades, the prevalence has escalated dramatically, with over 1.3 billion people now affected, a concerning rise from 650 million in the 1990s. Alarmingly, almost half of these individuals remain unaware of their condition, underscoring the need for enhanced awareness and screening efforts (WHO, 2023). Affecting approximately 26.4% of the adult population worldwide, with a comparable distribution across genders (26.6% of men and 26.1% of women), hypertension continues to drive a substantial portion of global mortality. It accounts for 10.4 million deaths annually, rendering it the leading contributor to premature death across the globe (Mackay and Mensah, 2004; Unger *et al*., 2020). The modern lifestyle marked by sedentary behaviors, poor dietary habits, and increasing rates of obesity has been intricately linked to the rising tide of hypertension (Neves *et al*., 2013).

Pharmacological and Non-Pharmacological Interventions

Effective management of hypertension encompasses both pharmacological and non-pharmacological strategies. Pharmacological options include thiazide diuretics, beta-blockers, loop diuretics, and ACE inhibitors (Akbari et al., 2023). However, despite their efficacy, many of these drugs come with undesirable side effects, such as electrolyte imbalances, fatigue, and sexual dysfunction, which often compromise patient compliance (Farzam and Jan, 2023). Moreover, achieving optimal blood pressure control remains a challenge for nearly 70% of patients receiving antihypertensive therapy (Mahmood *et al*., 2018). These limitations have fueled the exploration of complementary non-pharmacological approaches, with breathing exercises gaining prominence as an accessible, low-risk intervention. Therefore, this review aimed to summarize, interpret, and integrate existing literature on commonly practiced breathing techniques, their physiological mechanisms, and their therapeutic potential for hypertension and cardiovascular health improvement.

The major breathing techniques identified in the literature and their proposed mechanisms, potential cardiovascular benefits, and current evidence are summarized in Table 1 and discussed below.

Table 1: Summary of Common Breathing Exercises and Their Potential Effects on Hypertension and Cardiovascular Health

Breathing Technique	Basic Description	Proposed Physiological Mechanism	Potential Cardiovascular Benefits	Current Evidence / Notes
Diaphragmatic Breathing	Slow, deep breathing using the diaphragm with abdominal expansion during inhalation	Enhances parasympathetic activity, reduces sympathetic tone, improves oxygenation, and lowers stress response	May reduce blood pressure, heart rate, and stress while improving relaxation	One of the most studied and commonly recommended techniques
Slow Deep Breathing	Controlled slow breathing, often at 5–6 breaths per minute	Improves baroreflex sensitivity, autonomic balance, and vascular relaxation	May lower systolic and diastolic blood pressure and improve heart rate variability	Frequently studied in hypertension management
4-7-8 Breathing	Inhale for 4 seconds, hold for 7 seconds, exhale for 8 seconds	Promotes relaxation, reduces sympathetic activation, and improves breathing control	May support blood pressure control through stress reduction	Limited direct clinical evidence; promising relaxation technique
Box Breathing	Equal inhale-hold-exhale-hold pattern (e.g., 4-4-4-4 seconds)	Stabilizes breathing rhythm, reduces stress response, and improves autonomic regulation	May reduce anxiety, heart rate, and indirectly support blood pressure regulation	More evidence in stress management than hypertension
Alternate Nostril Breathing	Breathing alternately through one nostril at a time	Balances autonomic nervous system, improves respiratory efficiency, and reduces stress	May improve blood pressure control, heart rate variability, and relaxation	Commonly studied in yoga-based interventions
Pursed-Lip Breathing	Inhale through the nose and exhale slowly through pursed lips	Prolongs exhalation, reduces respiratory effort, and improves gas exchange	May reduce breathlessness and indirectly support cardiovascular health	More established in respiratory disease than hypertension
Device-Guided Slow Breathing	Use of device or audio cues to guide slow breathing rate	Encourages regular slow breathing, autonomic modulation, and improved baroreflex sensitivity	May reduce blood pressure in some hypertensive patients	Clinical studies available; adherence and cost may affect use

Breathing Exercises in Hypertension Management

Emerging research highlights the potential of breathing exercises as a novel, non-pharmacological intervention in the management of hypertension. By modulating the autonomic nervous system (ANS), particularly enhancing parasympathetic activity while reducing sympathetic overactivity, these techniques have demonstrated significant promise in lowering blood pressure (Joseph *et al*., 2005; Forouzanfar *et al*., 2016). A comprehensive review by Garg et al. (2023), which included a systematic review and meta-analysis of 15 studies, confirmed the significant impact of various breathing exercises such as slow breathing, yogic breathing, alternate nostril breathing, among others, on reducing systolic blood pressure (SBP) and diastolic blood pressure (DBP). Their findings revealed that while SBP reductions were significant in the intervention group, the DBP reduction, though lower, was still notable compared to the control group. Heart rate (HR) also saw a significant decrease in those that engaged in breathing exercises, indicating the broad cardiovascular benefits of these techniques.

Diaphragmatic Deep Breathing (DDB)

Diaphragmatic deep breathing (DDB), also known as slow abdominal breathing, has garnered attention for its potent ability to induce vasodilation and reduce blood pressure through enhanced oxygen exchange and prolonged diaphragmatic contraction. By slowing the breathing rate to 6–10 breaths per minute, DDB has been shown to significantly improve both systolic and diastolic blood pressure (Wang *et al*., 2010; Chen *et al*., 2017). Furthermore, DDB promotes improved baroreflex sensitivity (BRS) and autonomic balance, making it particularly effective for hypertensive patients (Joseph *et al*., 2005; Oneda *et al*., 2010). A study conducted by Vieira *et al*. (2014) further supports the impact of DDB and similar techniques on the respiratory system, reporting increased tidal volume, reduced respiratory rate, and enhanced abdominal contribution during diaphragmatic breathing, contributing to its efficacy in hypertension management.

4-7-8 Breathing Pattern

The 4-7-8 breathing pattern, pioneered by Dr. Andrew Weil, is grounded in the ancient yogic practice of pranayama. This technique involves inhaling for 4 seconds, holding the breath for 7 seconds, and exhaling for 8 seconds. Through this controlled breathwork, practitioners experience a marked reduction in oxygen consumption, heart rate, and blood pressure, along with improved vagal tone and sympathovagal balance (Russo *et al*., 2017). Short-term application of the 4-7-8 technique yields immediate reductions in blood pressure, while long-term practice contributes to decreased cardiovascular risk (Chinagudi *et al*., 2014).

Box Breathing

Box breathing, also known as four-square breathing, entails equal-duration cycles of inhaling, holding, exhaling, and holding the breath again, typically for four seconds each. This rhythmic breathing pattern is designed to activate the

parasympathetic nervous system, which helps alleviate stress, lower blood pressure, and stabilize heart rate. Verbraecken (2016) conducted a study with 30 participants (15 males and 15 females) that practiced box breathing twice daily for 30 days. The results revealed a significant improvement in pulmonary function parameters such as Forced Vital Capacity (FVC), Forced Expiratory Volume (FEV1), and Forced Inspiratory Vital Capacity (FIVC). These findings suggest that box breathing not only impacts cardiovascular health but also enhances lung function, making it a versatile tool in managing hypertension. Its widespread use among military personnel and athletes underscores its effectiveness in managing physiological responses to stress (Verbraecken, 2016; Garg *et al*., 2023).

Nostril Breathing

Nostril breathing, especially alternate nostril breathing, has been shown to stimulate the vagus nerve, a key regulator of parasympathetic activity, thereby reducing heart rate and blood pressure (Amandeep *et al.,* 2015). Research by Kalaivani *et al*. (2019) demonstrated that practicing alternate nostril breathing for just five days yielded significant reductions in both systolic and diastolic blood pressure among hypertensive patients. This simple yet effective technique offers a valuable tool for autonomic regulation and hypertension management.

Pursed-Lip Breathing

Pursed-lip breathing, a technique traditionally employed by patients with chronic obstructive pulmonary disease (COPD), involves slow inhalation through the nose followed by prolonged exhalation through pursed lips. This method effectively reduces respiratory rate, heart rate, and blood pressure, offering hypertensive patients an additional, practical strategy for immediate blood pressure reduction (Sharaf *et al*., 2020). Herawati *et al*. (2023) conducted a scoping review on breathing exercises and found that across 20 studies on hypertensive patients, techniques like pursed-lip breathing and slow breathing consistently reduced both systolic and diastolic blood pressure. While only three studies reported no significant change, the majority demonstrated a positive impact on cardiovascular and autonomic health.

Device-Guided Breathing

Device-guided slow breathing has also emerged as a promising intervention for hypertension. de Barros *et al*. (2017) conducted a randomized open-label clinical trial on 32 hypertensive patients to assess the effects of device-guided breathing on sympathetic nervous activity. After an 8-week intervention where participants practiced device-guided breathing for 15 minutes daily, there was a reduction in systolic and diastolic blood pressure during the waking period, although no changes were observed in office blood pressure. Interestingly, this study also recorded an increase in heart rate post-intervention, suggesting a nuanced response to long-term breathing interventions.

Current Research Gap

While numerous studies have explored the effects of individual breathing techniques on cardiovascular and pulmonary function, there is a noticeable lack of research examining the combined effects of multiple breathing exercise patterns. Verbraecken *et al*. (2016) investigated the impact of box breathing on pulmonary parameters, and Garg et al. (2023) reviewed several breathing exercises (such as alternate nostril breathing and Ujjayi breathing) on blood pressure and heart rate. Additionally, de Freitas *et al*. (2022) and Herawati *et al*. (2023) examined the benefits of slow and device-guided breathing on hypertensive patients, with a focus on autonomic regulation and sympathetic nervous activity. However, these studies primarily focus on singular breathing techniques, leaving a significant gap regarding the potential synergistic effects when different breathing exercises are combined.

CONCLUSION

Hypertension remains a major global health challenge, and pharmacological treatment alone may be limited by side effects, poor adherence, and incomplete blood pressure control. In this context, breathing exercises represent promising, low-cost, and non-invasive adjunctive strategies for hypertension management. Techniques such as diaphragmatic deep breathing, 4-7-8 breathing, box breathing, alternate nostril breathing, pursed-lip breathing, and device-guided slow breathing have shown potential benefits in lowering blood pressure, improving autonomic balance, reducing stress, and supporting cardiopulmonary function. Future studies are needed to evaluate the effectiveness of combined breathing approaches, establish optimal frequency and duration, determine long-term adherence and assess their benefits across diverse hypertensive populations to support the integration of breathing-based interventions into comprehensive hypertension management.

REFERENCES

Abdulrauf, R. A., Farouk, A., Adamu, J., Nmadu, J. N., & Awwalu, S. (2025). Comparison of Arterial Blood Pressure in Sickle Cell Patients and non-Sickle cell Young adults in Zaria, Kaduna State Nigeria. *Fudma Journal of Sciences*, *9*(1), 346-350.

Akbari, P., and Khorasani-Zadeh, A. (2023). Thiazide diuretics. In *StatPearls*. StatPearls Publishing.

Amandeep, K., Preksha, M., & Divya, S. (2015). Effectiveness of abdominal breathing exercise on blood pressure among hypertensive patients. *International Journal of Therapeutic Applications*, *24*, 39-49.

Chen, Y. F., Huang, X. Y., Chien, C. H., & Cheng, J. F. (2017). The effectiveness of diaphragmatic breathing relaxation training for reducing anxiety. *Perspectives in psychiatric care*, *53*(4), 329-336.

Chinagudi, S., Badami, S., Herur, A., Patil, S., Gv, S., & Ankad, R. (2014). Immediate effect of short duration of slow deep breathing on heart rate variability in healthy adults. *National Journal of Physiology, Pharmacy and Pharmacology*, *4*(3), 233-233.

de Barros, S., da Silva, G. V., de Gusmao, J. L., de Araujo, T. G., de Souza, D. R., Cardoso Jr, C. G., ... & Mion Jr, D. (2017). Effects of long-term device-guided slow breathing on sympathetic nervous activity in hypertensive patients: a randomized open-label clinical trial. *Blood Pressure*, *26*(6), 359-365.

de Freitas Gonçalves, K. S., Queiroz Godoy Daniel, A. C., Tatagiba Lamas, J. L., Oliveira, H. C., Cloutier, L., De Campos Pereira Silveira, R. C., & Veiga, E. V. (2022). Device and nondevice-guided slow breathing to reduce blood pressure in hypertensive patients: A systematic review and meta-analysis. *Health science reports*, *5*(3), e636.

Farzam, K., & Jan, A. (2023). Beta blockers. In *StatPearls [Internet]*. StatPearls Publishing.

Forouzanfar, M. H., Afshin, A., Alexander, L. T., Anderson, H. R., Bhutta, Z. A., Biryukov, S., ... & Carrero, J. J. (2016). Global, regional, and national comparative risk assessment of 79 behavioral, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The lancet*, *388*(10053), 1659-1724.

Garg, P., Mendiratta, A., Banga, A., Bucharles, A., Piccoli, M. V. F., Kamaraj, B., ... & Kashyap, R. (2024). Effect of breathing exercises on blood pressure and heart rate: A systematic review and meta-analysis. *International Journal of Cardiology Cardiovascular Risk and Prevention*, *20*, 200232.

Herawati, I., Mat Ludin, A. F., M, M., Ishak, I., & Farah, N. M. (2023). Breathing exercise for hypertensive patients: A scoping review. *Frontiers in physiology*, *14*, 1048338.

Joseph, C. N., Porta, C., Casucci, G., Casiraghi, N., Maffeis, M., Rossi, M., & Bernardi, L. (2005). Slow breathing improves arterial baroreflex sensitivity and decreases blood pressure in essential hypertension. *hypertension*, *46*(4), 714-718.

Kalaivani, S. K. M. P. G., Kumari, M. J., & Pal, G. K. (2019). Effect of alternate nostril breathing exercise on blood pressure, heart rate, and rate pressure product among patients with hypertension in JIPMER, Puducherry. *Journal of education and health promotion*, *8*(1), 145.

Mackay, J., & Mensah, G. A. (2004). *The atlas of heart disease and stroke*. World Health Organization.

Mahmood, S., Shah, K. U., Khan, T. M., Nawaz, S., Rashid, H., Baqar, S. W. A., & Kamran, S. (2019). Non-pharmacological management of hypertension: in the light of current research. *Irish Journal of Medical Science (1971-)*, *188*(2), 437-452.

Neves, A. L., Coelho, J., Couto, L., Leite-Moreira, A., & Roncon-Albuquerque Jr, R. (2013). Metabolic endotoxemia: a molecular link between obesity and cardiovascular risk. *J Mol endocrinol*, *51*(2), R51-64.

Ojo, A. E., Ojji, D. B., Grobbee, D. E., Huffman, M. D., & Peters, S. A. (2024). The burden of cardiovascular disease attributable to hypertension in Nigeria: a modelling study using summary-level data. *Global Heart*, *19*(1), 50.

Oneda, B., Ortega, K. C., Gusmao, J. L., Araujo, T. G., & Mion, D. (2010). Sympathetic nerve activity is decreased during device-guided slow breathing. *Hypertension Research*, *33*(7), 708-712.

Russo, M. A., Santarelli, D. M., & O'Rourke, D. (2017). The physiological effects of slow breathing in the healthy human. *Breathe*, *13*(4), 298-309.

Sharaf, A. Y., Ghaleb, M. A., & Ahmed, R. F. (2020). Effect of pursed lip breathing exercise on physiological parameters among patients with chronic obstructive pulmonary disease. *Int J Novel Res Healthc Nurs*, *7*(1), 687-701.

Unger, T., Borghi, C., Charchar, F., Khan, N. A., Poulter, N. R., Prabhakaran, D., ... & Schutte, A. E. (2020). 2020 International Society of Hypertension global hypertension practice guidelines. *Hypertension*, *75*(6), 1334-1357.

Verbraecken, J. (2016). Telemedicine applications in sleep disordered breathing: thinking out of the box. *Sleep medicine clinics*, *11*(4), 445-459.

Vieira, D. S., Mendes, L. P., Elmiro, N. S., Velloso, M., Britto, R. R., & Parreira, V. F. (2014). Breathing exercises: influence on breathing patterns and thoracoabdominal motion in healthy subjects. *Brazilian journal of physical therapy*, *18*(6), 544-552.

Wang, S. Z., Li, S., Xu, X. Y., Lin, G. P., Shao, L., Zhao, Y., & Wang, T. H. (2010). Effect of slow abdominal breathing combined with biofeedback on blood pressure and heart rate variability in prehypertension. *The Journal of Alternative and Complementary Medicine: Paradigm, Practice, and Policy Advancing Integrative Health*, *16*(10), 1039-1045.

World Health Organization. (2023). *Global report on hypertension: the race against a silent killer*. World Health Organization.

World Heart Federation. (2023). World heart report 2023: confronting the world's number one killer.