

<https://africanjournalofbiomedicalresearch.com/index.php/AJBR>

Afr. J. Biomed. Res. Vol. 27(4s) (December 2024); 11773-11780

Research Article

Role of Breathing Practices (Pranayama) in Bronchial Asthma: A Systematic Review

Chhaya Negi¹, Rohit Kumar^{1*}, Vijay Shanker Yadav², Mohit Kumar², Dr. Mohit Bhatia³, Dr. Sunanda R. Pedhekar⁴

^{1*}PhD Scholar Department of Kayachikitsa, Faculty of Ayurveda Institute of Medical Sciences Banaras Hindu University, Varanasi 221005

²PhD Scholar Department of Sangyahan, Faculty of Ayurveda Institute of Medical Sciences Banaras Hindu University, Varanasi 221005

³Associate Professor Department of T.B. & Respiratory Diseases, Institute of Medical Sciences Banaras Hindu University, Varanasi 221005

⁴Professor Department of Kayachikitsa, Faculty of Ayurveda Institute of Medical Sciences Banaras Hindu University, Varanasi 221005

***Corresponding Author:** Rohit Kumar

*Ph.D Scholar, Department of Kayachikitsa, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India, 221005. e-mail address: rohit812797@bhu.ac.in, Mob no: +918127973433

Abstract

Background: Pranayama, which is the practice of yogic breathing, has shown various positive health benefits. Currently, there are no comprehensive reviews assessing the health advantages of pranayama practiced in isolation.

Aim: The objective of this research is to conduct a systematic review regarding the positive health impacts of pranayama.

Methods: The data were collected through a stepwise search methodology by exploring the online databases of PubMed, Google Scholar, ResearchGate, Clinical Key, and Academia to find relevant literature with specific keywords. We included controlled clinical trials involving humans that utilized “Pranayama” as an intervention, had a suitable control group, and assessed health-related outcomes.

Results: Initial database searches identified 369 potentially eligible articles, from which 10 studies meeting the specified inclusion and exclusion criteria were selected. All these studies were controlled trials, comprising nine randomized trials and one crossover study. The participant numbers ranged from 20 to 144, while the duration of pranayama practice varied between 6 days and 3 months. The findings indicated a significant effect on cardiorespiratory functions among individuals with bronchial asthma, evidenced by improvements in pulse rate, systolic blood pressure, and respiratory function measurements. Moreover, a reduction in the frequency and severity of attacks was observed, alongside a diminished requirement for medication and an enhancement in quality of life (QOL). In patients with chronic obstructive pulmonary disease, there were noted improvements in symptoms, activity, and impact scores.

Conclusions: The available evidence concerning pranayama indicates that it provides both physiological and psychological benefits. The most notable positive effects have been observed in patients with respiratory conditions, particularly bronchial asthma. Additionally, individuals with cardiovascular disease have also experienced improvements. However, further high-quality randomized trials are essential to establish definitive evidence.

Keywords: Pranayama, Therapeutic benefit, Expiratory breathing exercises, Yogic breathing

***Author for correspondence: Email:** rohit812797@bhu.ac.in

Received 15/11/2024, Acceptance 30/12/2024

DOI: <https://doi.org/10.53555/AJBR.v27i4S.5927>

© 2024 The Author(s).

This article has been published under the terms of Creative Commons Attribution-Noncommercial 4.0 International License (CC BY-NC 4.0), which permits noncommercial unrestricted use, distribution, and reproduction in any medium, provided that the following statement is provided. "This article has been published in the African Journal of Biomedical Research"

INTRODUCTION

The global prevalence of bronchial asthma is rising. This condition is marked by symptoms such as coughing, wheezing, and difficulty breathing, particularly during expiration [1]. Various factors, including environmental elements, infections, workplace exposures, cold weather, and physical activity, can worsen the condition [2]. Currently, the strategy for managing the disease involves the use of pharmacological treatments, either through inhaled or oral medications. While this treatment is initially effective for controlling the condition, it eventually leads to increased financial costs, greater morbidity (with more patients needing oxygen or respiratory support), and heightened mortality rates [3].

Pranayama is a precise discipline. It is the fourth limb of Ashtanga Yoga. "Tasmin Sati Svasa prasvasayorgativicchedah Pranayamah"—Controlling the breath or Prana involves the cessation of inhalation and exhalation, which occurs after achieving stability in posture or Asana. This definition of Pranayama is found in *Patanjali Yoga Sutras, Chapter II-49*. 'Svasa' refers to the inhalation, while 'Prasvasa' denotes exhalation [4]. The breath is the outer expression of Prana, the life force. Breath, like electricity, is the gross form of Prana. Breath is Sthula, or gross, whereas Prana is Sukshma, meaning subtle. You can gain control over the subtle Prana within by mastering your breathing. Regulating Prana equates to regulating the mind [5].

Breathing retraining is the most frequently utilized technique in both research and the treatment of asthma. The goal is to "normalize" breathing patterns by slowing the respiratory rate, extending the expiratory phase, and decreasing overall ventilation [6]. In addition, there is a focus on using abdominal muscles for resting breathing instead of the muscles of the thoracic cage, as well as promoting nasal breathing over mouth breathing. This approach is based on the abnormal or dysfunctional breathing patterns, such as hyperventilation, observed in individuals with asthma [7].

Pranayama by itself has shown a variety of positive health outcomes, [8] such as reducing stress, having a favorable impact on cardiovascular health, [9] improving respiratory function, and boosting cognitive abilities [10]. Nonetheless, currently, there are no comprehensive reviews assessing the positive health impacts of pranayama as an independent practice. Thus, this study seeks to conduct a systematic review of the research conducted on the health benefits associated with pranayama.

METHODS

The present systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

LITERATURE SEARCH

Data were acquired through a systematic stepwise search that explored various online databases, including PubMed (U.S. National Library of Medicine, USA), Google Scholar (Thomson Reuters, USA), Clinical Key, and Academia. The search utilized specific keywords: "Pranayama," "Pranayam," "Pranayamas," "Yogic Breathing Exercise," and "Yoga Breathing Exercise." The search parameters were confined to studies involving human subjects, and excluded from this search were conference proceedings, editorials, commentaries, case reports, qualitative studies, book chapters, and reviews.

In the subsequent phase, the total number of results obtained from the databases was aggregated, and duplicate entries were removed. Following this, the studies were meticulously screened by assessing the "title," "abstract," and "full text" of each manuscript. Studies that did not conform to the established inclusion criteria were eliminated during this stage. A manual search was conducted to supplement the data using the reference lists from the articles selected in the final stage. This comprehensive search process was executed by two independent reviewers (RJ and HR), and the final selection of articles included in the review was reached through an iterative consensus process amongst the reviewers.

INCLUSION/EXCLUSION CRITERIA

1. The study must employ a randomized controlled design and crossover study.
2. It is essential for the study to include authenticated assessments of quality of life (QOL), lung function, as well as the signs and symptoms of bronchial asthma. Studies that do not meet these criteria will be excluded from the review.
3. Controlled clinical trials & crossover studies involving human subjects will be considered.
4. The intervention must consist of "Pranayama" along with a suitable non-yoga control group.
5. Health-related outcomes will be evaluated between the intervention and control groups utilizing clinical measurements. The review is limited to studies conducted with human participants and published in English. Data extraction from the included studies will be carried out by a single reviewer (HR), with accuracy verification performed by a second reviewer (RJ) using a standardized form.

DATA EXTRACTION, AND ANALYSIS

The data extracted from each study were as follows: Study details were compiled, including the first author, year of publication, and country of the research. The methods employed in each study were examined, detailing sample size, age, and the male-to-female ratio within both intervention and control groups. The study

design was assessed for features such as randomization, blinding, and the duration of the study. Furthermore, the intervention and control specifics were documented, including the method and type of yoga breathing exercises and their frequency and duration. Outcome measurements encompassed both clinical and biochemical parameters. Any discrepancies in the extracted data were addressed through discussion, with the involvement of a third reviewer when necessary. Additional data not accessible in the published manuscript were sought from corresponding authors or computed using the available published data.

QUALITY ASSESSMENT

The PEDro scale was employed to evaluate the methodological quality of the trials included in the systematic review [11]. Each study was assigned a score ranging from 0 to 10 based on the following criteria: random allocation, concealed allocation, similarity at baseline, subject blinding, therapist blinding, assessor blinding, a follow-up rate exceeding 85% for at least one key outcome, intention-to-treat analysis, statistical comparison between groups for at least one key outcome, and point and variability measures for at least one key outcome. The PEDro scale classifies studies as

"good" quality (scores from 6 to 10), "fair" quality (scores from 4 to 5), and "poor" quality (scores below 4) [12].

RESULTS

The initial search conducted across multiple databases, including PubMed, Google Scholar, ResearchGate, Clinical Key, and Academia, identified 369 potentially eligible articles. Following the consolidation of results from these five databases and the removal of duplicate entries, 155 articles remained. Additionally, nine articles sourced from other platforms were incorporated, resulting in a total of 164 articles. A screening process based on title and abstract analysis led to the exclusion of 105 articles that did not meet the established inclusion criteria. Among the remaining 50 articles, a full-text review identified 10 studies that satisfied the specified inclusion and exclusion criteria. Notably, nine of these studies focused on respiratory diseases, encompassing conditions such as asthma and chronic obstructive pulmonary disease (COPD), while one study pertained to patients with hypertension and cardiovascular diseases through mindfulness. A summary of the search strategy is depicted in **Figure 1**, and the characteristics of each study are detailed in **Table 1**.

Flow Chart (PRISMA) Figure 1

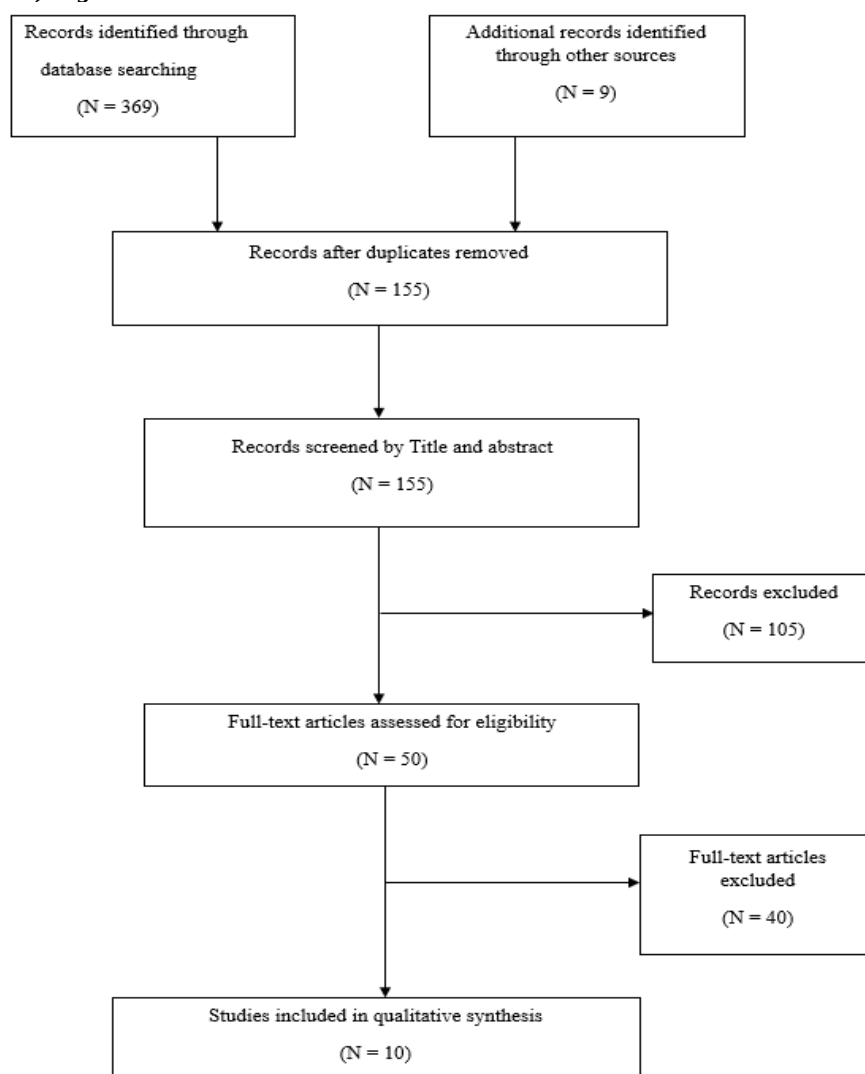


Table 1 Summary of included studies

Author, year of Publication, Country (Reference)	Objectives	Study Design	Duration of Pranayama	Participants n Intervention * n Control	Details of Intervention
Bhatt and Rampallivar 2016, India [13]	Effect of Pranayama on ventilator functions in Asthma patients	R, C	3 months	40 40	Different types of Pranayama (Bhastrika, Kapalbhathi, Anuloma – Viloma, Bharamari and Ujjayi
Prem al., 2013, India [14]	Effect of Pranayama on QOL and Pulmonary function in patients with Bronchial Asthma	R, C	3 months	40 40	Patients trained to perform diaphragmatic breathing, thoracic breathing, deep yogic
Saxena and Saxena 2009, India [15]	Effect of Pranayama in patients with mild moderate Bronchial Asthma	R, C	12 weeks	25 25	Practice of Deep breathing, Anuloma-Vilom, Bhramari, and Omkara
Singh et al., 1990, UK [16]	Effect of Pranayama on airway reactivity in Subjects with Bronchial Asthma	R, C	3 months	22 22	Practice of slow deep breathing
Sodhi et al., 2014, India [17]	Effect of Pranayama QOL in patients with Bronchial Asthma	R, C	6 weeks	60 60	Pranayama (deep breathing, Kapalbhathi, Bhastrika, Ujjayi)
Sodhi et al., 2009, India [18]	Effect of Pranayama on Pulmonary functions in patients with Bronchial Asthma	R, C	3 months	60 60	Yoga breathing exercises (Deep breathing, Kapalbhathi, Bhastrika, Ujjayi and Bhramari
Katiyar and Bihari 2006, [19]	Effect of Pranayama patients with COPD	R, C	3 months	24 24	Performance of Pramayama
Kochupillai et al., 2005, India [20]	Effect of Pranayama on Immune functions in Bronchial Asthma	R, C	3 months	10 10	Pranayama (Ujjayi and Bhastrika)
Pushpa K et al., 2018, India [21]	Effect of Pranayama on Bronchial Asthma	R, C	6 weeks	30 30	Deep Yogic breathing
Ainsworth B et al., 2022, United Kingdom [22]	Effect of Pranayama & Mindfulness Program on Asthma	R, C	3 months	93 51	Yoga breathing exercises (Deep & Slow breath, Anulom – Vilom, Kapalbhathi, Bhramari and Ujjayi

All studies included in the review were controlled trials, comprising 9 randomized trials and 1 cross-over study. Most of the studies were conducted in India (n = 10). Participant numbers varied from 20 to 144, with the duration of pranayama practice ranging from 6 days to 3 months. Most studies included participants of both genders. The methodological quality of the trials was assessed using the Pedro scale, which identified 2 studies with “poor” quality (score 0–4), 3 studies with “fair” quality (score 4–5), and 5 studies with “good” quality (score 6–8).

Nine studies investigated the impact of pranayama on individuals with bronchial asthma, while a single study focused on patients with COPD. Bhatt and Rampallivar

assessed how pranayama influenced ventilatory functions in asthma patients [13]. The study involved 80 asthma patients who were evenly divided into two groups; the intervention group practiced pranayama alongside their medication for 3 months. Measurements such as pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP), respiratory rate, peak expiratory flow rate (PEFR), forced expiratory volume in 1 second (FEV1), and forced vital capacity (FVC) were taken from all participants. The test results showed a notable enhancement in PR ($P < 0.05$), SBP ($P < 0.05$), FVC ($P < 0.05$), PEFR ($P < 0.05$), and FEV1 ($P < 0.001$) in the post-test outcomes when compared to the pretest results for the intervention group. Conversely, the control group did not show any significant changes. A

similar investigation by Saxena and Saxena explored the effects of pranayama in patients with mild-to-moderate bronchial asthma ($n = 50$) over 12 weeks [15]. Measurements of FEV1 and PEFr were taken from all participants at the beginning and after 12 weeks. Significant symptom reduction and improvements in FEV1 and PEFr were noted in the intervention group ($P < 0.001$) compared to the control group after engaging in pranayama practices.

A randomized controlled trial (RCT) carried out by Sodhi et al [17, 18], involving 120 patients with bronchial asthma over 6 weeks, revealed a statistically significant improvement ($P < 0.01$) in the percentage of predicted PEFr, FEV1, FEF25-75, FVC, and the FEV1/FVC% ratio at both 4 and 6 weeks in the group practicing yoga breathing compared to the control group. Singh et al. examined the effects of slow-deep breathing using the Pink City Lung (PCL) exerciser in patients with bronchial asthma [16]. During the control period, patients were instructed to use a matched placebo device for breathing. The mean levels of FEV1, PEFr, symptom scores, and the frequency of inhaler use over the last 3 days of each treatment phase were evaluated. Improvements were greater with the PCL exerciser than with the placebo device; however, these differences did not reach statistical significance. A notable increase in the amount of histamine required to induce a 20% drop in FEV1 during pranayama breathing was observed with the PCL exerciser ($P = 0.013$), but this effect was not seen with the placebo device.

Numerous controlled studies have assessed the impact of Pranayama on the quality of life (QOL) in individuals with bronchial asthma. An RCT conducted in India by Prem et al. aimed to compare the effects of pranayama breathing methods on QOL in asthma patients ($n = 80$). Participants were divided into three equal groups, with the control group ($n = 40$) receiving standard pharmacological treatment [14]. In the two intervention groups, one group practiced pranayama ($n = 40$), while the other group practiced Buteyko (breathing practice) ($n = 40$) over a training duration of 3 months. Pre- and post-training measurements of the Asthma Quality of Life Questionnaire (AQLQ), Asthma Control Questionnaire, and pulmonary function tests were collected from all participants. In the comparison between the pranayama and control groups, pranayama demonstrated a significant improvement ($P = 0.042$) in the overall AQLQ score. However, the Buteyko group exhibited greater enhancement in the total AQLQ score compared to the Pranayama group ($P = 0.056$). Similar findings were noted in the study by Sodhi et al., [17, 18] which highlighted a significant improvement in the “symptoms,” “activities,” and “environmental” segments of the AQLQ at 8 weeks ($P < 0.01$) in the yoga group compared to the control group. They also reported a marked decrease in the frequency and intensity of attacks, alongside a reduction in medication needs at 4 and 8 weeks ($P < 0.01$) in the yoga group when compared to the baseline.

A randomized controlled trial (RCT) by Katiyar and Bihari assessed the impact of pranayama over three months on the rehabilitation of patients with [19] COPD ($n = 48$). The St. George's Respiratory Questionnaire

(SGRQ) was utilized to evaluate the participants' overall health, while all subjects underwent spirometry tests, a 6-minute walk test (6-MWT), and arterial blood gas (ABG) analysis. The findings revealed a statistically significant reduction in the symptom score ($P = 0.03$), activity score ($P < 0.005$), impact score ($P < 0.008$), and total SGRQ score ($P = 0.02$) among those in the intervention group, unlike the control group. Although the increase in FVC and FEV1 for the intervention group was not statistically significant, the rise in PEF was significant ($P = 0.05$) specifically for the intervention group. Regarding the results from the 6-MWT, a small yet significant increase in distance ($P = 0.05$) was noted in the intervention group. Pranayama has also shown positive effects on respiratory function (FVC) and chest expansion.

DISCUSSION

This systematic review represents a pioneering effort to thoroughly evaluate the existing literature on the beneficial health effects of Pranayama yoga practice. The findings indicate a significant impact on cardio-respiratory functions in patients diagnosed with bronchial asthma, evidenced by improvements in parameters such as pulse rate, systolic blood pressure, forced vital capacity, forced expiratory volume in one second, and peak expiratory flow rate. Furthermore, there was a notable reduction in the frequency and severity of asthma attacks, as well as a decreased requirement for medication, accompanied by enhancements in quality of life. In patients with chronic obstructive pulmonary disease (COPD), Pranayama practice resulted in improved symptom management, activity levels, and overall impact scores. Consequently, the available evidence from controlled studies supports the assertion that Pranayama yields both physiological and psychological benefits.

The primary beneficial effect of Pranayama practice has been identified in patients suffering from respiratory illnesses, notably bronchial asthma [23]. Various mechanisms are believed to contribute to the positive respiratory outcomes associated with Pranayama. This practice may facilitate bronchial dilation by addressing abnormal breathing patterns and alleviating the muscle tone of the respiratory muscles [24]. Additionally, yoga training is anticipated to enhance the strength of both expiratory and inspiratory muscles, thereby improving pulmonary function. For instance, “Bhastrika” Pranayama involves rapid and forceful breathing, which engages both inspiratory and expiratory muscles [25]. Furthermore, techniques such as Kapalbhathi, which utilizes abdominal and diaphragmatic muscles, train individuals to fully utilize these muscle groups during breathing [26]. This approach is likely to assist in the expulsion of secretions from the bronchial tree and alveoli, thus creating additional space for air intake. Lung inflation approaching total lung capacity serves as a significant stimulus for the release of lung surfactant into the alveolar spaces, which enhances lung compliance [27]. The slow and gentle breathing characteristic of certain Pranayama techniques reduces frictional stress, thereby stabilizing mast cell degranulation and mitigating airway inflammation and obstruction [26]. Deep

inhalation, breath retention, and gradual exhalation contribute to increased lung capacity and progressively improve pulmonary functions.

The observed enhancements in pulmonary function are likely implicated in the reductions in severity, frequency, and medication requirements experienced by patients with bronchial asthma, ultimately leading to improved quality of life in this population [27]. Similar mechanisms may underlie the improvements noted in individuals with Chronic Obstructive Pulmonary Disease (COPD). However, it is crucial to acknowledge a reported case of pneumothorax associated with the practice of Kapalabhati Pranayama [28]. Therefore, the careful selection of suitable Pranayama techniques, along with appropriate supervision and training, is essential for patients with compromised respiratory functions.

The long-term effects of pranayamic breathing include enhancements in autonomic function. Recent controlled trials indicate that yoga training programs can effectively reduce perceived stress, elevate mood, and decrease levels of catecholamines and cortisol [29]. These programs also demonstrate improved cardiovascular responses to stress, reduced blood pressure, and other metrics of sympathetic activation in both healthy individuals and clinical populations [24]. Yoga practices facilitate a shift in the autonomic nervous system balance from a predominantly sympathetic state to a parasympathetic state by directly augmenting parasympathetic output, potentially through vagal stimulation. This results in favorable changes in cardiovagal function, along with associated neuroendocrine and inflammatory profiles, enhancements in sleep quality, emotional well-being, and related metabolic parameters [30]. Furthermore, slow pranayamic breathing generates inhibitory signals and hyperpolarizing currents within both neural and non-neural tissues by mechanically stretching tissues during the inhalation and retention phases.

Increased melatonin production following a regimen of slow-breathing pranayama exercises has been associated with the relaxation and well-being generated by these practices. During controlled breathing exercises, the stretching of lung tissue elicits inhibitory signals within the vagus nerve [31]. This response ultimately facilitates a shift in the autonomic nervous system towards parasympathetic dominance, which results in a calm and alert mental state [32]. Moreover, during both fast and slow pranayama practices, when participants intentionally concentrate on varying respiratory frequencies with the goal of relaxation, their attention is diverted from extraneous and distracting stimuli [33]. Therefore, it is evident that the beneficial psychological effects observed with pranayama practice are likely attributable to neurohumoral mechanisms, primarily involving the interaction between the sympathetic and parasympathetic nervous systems [34].

The current study possesses several noteworthy strengths, including a comprehensive and easily replicable search strategy implemented across five major medical databases. Furthermore, the selection of studies was performed systematically through the application of clearly defined inclusion and exclusion criteria. Nonetheless, several limitations must be considered

before drawing definitive conclusions from the results of this analysis. There is a lack of uniformity among the various studies; the yogic interventions, assessed outcomes, study populations, sample sizes, and durations of intervention exhibited significant heterogeneity.

CONCLUSIONS

Pranayama is an accessible and cost-effective technique that has demonstrated therapeutic benefits for various patient populations. The existing literature supports both physiological and psychological advantages associated with its practice. Notable improvements have been predominantly reported among individuals suffering from respiratory conditions such as bronchial asthma. Additionally, pranayama has been shown to alleviate symptoms of fatigue, anxiety, and other emotional disturbances in patients with cardiovascular diseases. However, the studies conducted thus far exhibit considerable heterogeneity in terms of methodological rigor, specific pranayama techniques employed, and sample sizes. Consequently, there is a pressing need for further high-quality randomized controlled trials (RCTs) to furnish definitive evidence and enhance the understanding of the underlying mechanisms that contribute to the therapeutic benefits of pranayama.

REFERENCES

1. McFadden ER., Jr. Harrison's principles of Internal medicine. In: Fauci SA, Braunwald E, Kasper DL, Hauser SL, Longo DL, Jameson, editors. USA: McGraw Hill; 2005. p. 1511. [[Google Scholar](#)]
2. Nagarathna R, Nagendra HR. Yoga for bronchial asthma: A controlled study. *Br Med J*. 1985;291:1077-9. [[PMC free article](#)] [[PubMed](#)] [[Google Scholar](#)]
3. Goyeche JR, Ikeniy A. The Yoga Perspective part II: Yoga therapy in treatment of asthma. *J Asthma*. 1982;19:189-201. [[PubMed](#)] [[Google Scholar](#)]
4. B.K.S. Iyengar., Light on Yoga & Light on Pranayama. Hartranft C. *The Yoga-Sutra of Patanjali: A New Translation With Commentary*. India: Shambhala Classics; 2003. [[Google Scholar](#)]
5. Vedanathan PK, Kesavalu LN, Murthy K, Durall K, Hall MJ, et al. Nagarathna, Clinical study of Yoga Techniques in university students with asthma: A control study. *Allergy Asthma Proc*. 1998;19:3-9. [[PubMed](#)] [[Google Scholar](#)]
6. Ritz T, Roth WT. Behavioral interventions in asthma. Breathing training. *Behav Modif*. 2003;27:710-30. [[Article Google Scholar](#)]
7. Kosmas EN, Milic-Emili J, Polychronaki A, et al. Exercise-induced flow limitation, dynamic hyperinflation and exercise capacity in patients with bronchial asthma. *Eur Respir J*. 2004;24:378-84. [[Article CAS Google Scholar](#)]
8. Sharma VK, Trakroo M, Subramaniam V, Rajajeyakumar M, Bhavanani AB, Sahai A. Effect of fast and slow pranayama on perceived stress and cardiovascular parameters in young health-care students. *Int J Yoga*. 2013;6:104-10. [[PMC free article](#)] [[PubMed](#)] [[Google Scholar](#)]

9. Saxena T, Saxena M. The effect of various breathing exercises (pranayama) in patients with bronchial asthma of mild to moderate severity. *Int J Yoga*. 2009;2:22–5. [[PMC](#) [free article](#)] [[PubMed](#)] [[Google Scholar](#)]
10. Sharma VK, Rajajeyakumar M, Velkumary S, Subramanian SK, Bhavanani AB, Madanmohan, et al. Effect of fast and slow pranayama practice on cognitive functions in healthy volunteers. *J Clin Diagn Res*. 2014;8:10–3. [[PMC](#) [free article](#)] [[PubMed](#)] [[Google Scholar](#)]
11. de Morton NA. The PEDro scale is a valid measure of the methodological quality of clinical trials: A demographic study. *Aust J Physiother*. 2009;55:129–33. [[Google Scholar](#)]
12. Maher, C. G., Sherrington, C., Herbert, R. D., Moseley, A. M., & Elkins, M. (2003). Reliability of the PEDro scale for rating quality of randomized controlled trials. *Physical therapy*, 83(8), 713–721.
13. Bhatt A, Rampallivar S. Effect of pranayam on ventilatory functions in bronchial asthma patients. *J Evol Med Dent Sci*. 2016;5:1453–55. [[Google Scholar](#)]
14. Prem V, Sahoo RC, Adhikari P. Comparison of the effects of Buteyko and pranayama breathing techniques on quality of life in patients with asthma – A randomized controlled trial. *Clin Rehabil*. 2013;27:133–41. [[PubMed](#)] [[Google Scholar](#)]
15. Saxena T, Saxena M. The effect of various breathing exercises (pranayama) in patients with bronchial asthma of mild to moderate severity. *Int J Yoga*. 2009;2:22–5. [[PMC](#) [free article](#)] [[PubMed](#)] [[Google Scholar](#)]
16. Singh V, Wisniewski A, Britton J, Tattersfield A. Effect of yoga breathing exercises (pranayama) on airway reactivity in subjects with asthma. *Lancet*. 1990;335:1381–3. [[PubMed](#)] [[Google Scholar](#)]
17. Sodhi C, Singh S, Bery A. Assessment of the quality of life in patients with bronchial asthma, before and after yoga: A randomised trial. *Iran J Allergy Asthma Immunol*. 2014;13:55–60. [[PubMed](#)] [[Google Scholar](#)]
18. Sodhi C, Singh S, Dandona PK. A study of the effect of yoga training on pulmonary functions in patients with bronchial asthma. *Indian J Physiol Pharmacol*. 2009;53:169–74. [[PubMed](#)] [[Google Scholar](#)]
19. Katiyar S, Bihari S. Role of pranayama in rehabilitation of COPD patients – A randomized controlled study. *Indian J Allergy Asthma Immunol*. 2006;20:98–104. [[Google Scholar](#)]
20. Kochupillai V, Kumar P, Singh D, Aggarwal D, Bhardwaj N, Bhutani M, et al. Effect of rhythmic breathing (Sudarshan Kriya and pranayam) on immune functions and tobacco addiction. *Ann N Y Acad Sci*. 2005;1056:242–52. [[PubMed](#)] [[Google Scholar](#)]
21. K. Pushpa, D. Sharma, Yoga as a complementary therapy improves pulmonary functions in bronchial asthma patients: a randomized controlled trial, *Natl. J. Physiol. Pharm. Pharmacol*. 8 (12) (2018) 1704–1708. [[Google Scholar](#)]
22. Ainsworth Ben, Stanescu Sabina, Stuart Beth, Daniel Russell, Liddiard Megan, Djukanovic Ratko, et al., A feasibility trial of a digital mindfulness-based intervention to improve asthma-related quality of life for primary care patients with asthma, *J. Behav. Med*. 45 (1) (2022) 133–147. [[Google Scholar](#)]
23. Jain N, Srivastava RD, Singhal A. The effects of right and left nostril breathing on cardiorespiratory and autonomic parameters. *Indian J Physiol Pharmacol*. 2005;49:469–74. [[PubMed](#)] [[Google Scholar](#)]
24. Madanmohan, Thombre DP, Balakumar B, Nambinarayanan TK, Thakur S, Krishnamurthy N, et al. Effect of yoga training on reaction time, respiratory endurance, and muscle strength. *Indian J Physiol Pharmacol*. 1992;36:229–33. [[PubMed](#)] [[Google Scholar](#)]
25. Subbalakshmi NK, Saxena SK, Urmimala JA. Immediate effect of nadi -shodhana pranayama on some selected parameters of cardiovascular, pulmonary and higher functions of brain. *Thai J Physiol Sci*. 2005;18:10–6. [[Google Scholar](#)]
26. Karthik PS, Chandrasekhar M, Ambareesha K, Nikhil C. Effect of pranayama and suryanamaskar on pulmonary functions in medical students. *J Clin Diagn Res*. 2014;8:BC04–6. [[PMC](#) [free article](#)] [[PubMed](#)] [[Google Scholar](#)]
27. Joshi LN, Joshi VD, Gokhale LV. Effect of short term 'pranayam' practice on breathing rate and ventilatory functions of lung. *Indian J Physiol Pharmacol*. 1992;36:105–8. [[PubMed](#)] [[Google Scholar](#)]
28. Johnson DB, Tierney MJ, Sadighi PJ. Kapalabhati pranayama: Breath of fire or cause of pneumothorax? A case report. *Chest*. 2004;125:1951–2. [[PubMed](#)] [[Google Scholar](#)]
29. Singh S, Malhotra V, Singh KP, Madhu SV, Tandon OP. Role of yoga in modifying certain cardiovascular functions in type 2 diabetic patients. *J Assoc Physicians India*. 2004;52:203–6. [[PubMed](#)] [[Google Scholar](#)]
30. Innes KE, Selfe TK. Yoga for adults with type 2 diabetes: A systematic review of controlled trials. *J Diabetes Res*. 2016;2016:6979370. [[PMC](#) [free article](#)] [[PubMed](#)] [[Google Scholar](#)]
31. 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;67:566–71. [[PubMed](#)] [[Google Scholar](#)]
32. Harinath K, Malhotra AS, Pal K, Prasad R, Kumar R, Kain TC, et al. Effects of Hatha yoga and Omkar meditation on cardiorespiratory performance, psychologic profile, and melatonin secretion. *J Altern Complement Med*. 2004;10:261–8. [[PubMed](#)] [[Google Scholar](#)]
33. Sharma VK, Rajajeyakumar M, Velkumary S, Subramanian SK, Bhavanani AB, Madanmohan, et

- al. Effect of fast and slow pranayama practice on cognitive functions in healthy volunteers. *J Clin Diagn Res.* 2014;8:10–3. [[PMC free article](#)] [[PubMed](#)] [[Google Scholar](#)]
34. Das, M., Pundir, M., Nayak, P., Patra, S., & Thajuddin, N. (2023). Yogic diet on gut microbial diversity in asthma. *Yoga Mimamsa*, 55(1), 58-66.