

Yogic Breathing and Respiratory Function: Physiological Mechanisms, Respiratory Adaptations, and Clinical Implications: A Narrative Review

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Abstract

Background: Yogic breathing, commonly referred to as pranayama, involves conscious regulation of breathing pattern, depth, rate, and respiratory phases. Increasing evidence suggests that these practices may influence pulmonary function, respiratory muscle performance, autonomic regulation, and overall respiratory health. However, variations in breathing techniques and study methodologies make it important to synthesize the available evidence and understand the physiological basis of these effects.

Objective: This narrative review aims to examine the physiological mechanisms underlying yogic breathing, summarize the respiratory adaptations associated with regular practice, and discuss its potential clinical implications for respiratory health.

Methods: Relevant scientific literature examining yogic breathing and respiratory function was reviewed, including systematic reviews, meta-analyses, randomized controlled trials, and observational studies involving healthy individuals and clinical populations. The reviewed literature focused on pulmonary function parameters such as forced vital capacity (FVC), forced expiratory volume in one second (FEV1), peak expiratory flow rate (PEFR), maximal voluntary ventilation (MVV), respiratory muscle strength, and functional respiratory outcomes.

Results: The available evidence indicates that yogic breathing may improve selected aspects of pulmonary function and respiratory efficiency. Regular practice has been associated with improvements in lung volumes, expiratory flow rates, ventilatory capacity, and respiratory muscle performance. Slow and controlled breathing may also influence respiratory–autonomic interactions through modulation of vagal activity, respiratory sinus arrhythmia, and other autonomic mechanisms. In clinical populations, particularly individuals with asthma and chronic obstructive pulmonary disease, yoga-based breathing practices have demonstrated potential benefits in pulmonary function, symptom control, exercise tolerance, and quality of life when used alongside conventional management. Nevertheless, the magnitude of benefit varies according to the breathing technique, intervention duration, participant characteristics, and study design.

Conclusion: Yogic breathing appears to be a promising complementary approach for supporting respiratory function and respiratory health. Its potential effects may arise from coordinated changes in respiratory mechanics, respiratory muscle activity, ventilatory control, and autonomic regulation. Although current evidence is encouraging, methodological heterogeneity and limited long-term data

prevent definitive conclusions regarding standardized clinical protocols. Further well-designed randomized controlled trials are needed to establish technique-specific effects, optimal practice duration, and long-term clinical relevance.

Keywords: Yogic breathing; Pranayama; Pulmonary function; Respiratory function; Respiratory muscles; Asthma; Chronic obstructive pulmonary disease; Yoga

Introduction

Breathing is a continuous physiological process that is essential for maintaining adequate oxygen supply, carbon dioxide removal, and overall respiratory balance. Although breathing normally occurs automatically, it can also be consciously regulated through yogic breathing practices, commonly referred to as *pranayama*. These practices involve deliberate control of the rate, depth, rhythm, and pattern of breathing and may include controlled inhalation, exhalation, and breath retention. Because of these characteristics, yogic breathing has received increasing scientific attention for its potential effects on respiratory and physiological health (*Saoji et al., 2019*). Regular practice of yogic breathing may influence respiratory function by promoting slower, deeper, and more controlled breathing patterns. Research has examined its effects on important pulmonary function parameters such as forced vital capacity (FVC), forced expiratory volume in one second (FEV₁), and peak expiratory flow rate (PEFR). A recent systematic review and meta-analysis of healthy adults reported beneficial effects of different yogic breathing practices on FVC, FEV₁, FEV₁/FVC, and PEFR, although considerable variation was observed among the included studies (*Bandyopadhyay et al., 2026*). Evidence from clinical populations has also indicated improvements in selected pulmonary-function measures following yoga-based interventions, although not all respiratory outcomes have shown consistent changes (*Rathore et al., 2025*).

The effects of yogic breathing may extend beyond changes in lung-function measurements. Controlled breathing can influence respiratory mechanoreceptors and chemoreceptors and may subsequently affect brainstem respiratory regulation and autonomic activity. These responses have been proposed as possible physiological pathways through which pranayama may produce respiratory and cardiorespiratory adaptations (*Mondal, 2024*). Earlier evidence has similarly suggested that yogic breath regulation may produce a range of physiological and clinical effects, although differences in techniques, study designs, and participant characteristics make direct comparison between studies difficult (*Saoji et al., 2019*). Therefore, the present narrative review aims to examine the relationship between yogic breathing and respiratory function, with particular emphasis on its **physiological mechanisms, respiratory adaptations, and potential clinical implications**. By bringing these aspects together, the review seeks to provide a clear understanding of how controlled yogic breathing may influence respiratory function and how current scientific evidence may support its role as a complementary approach to respiratory health.

Yogic Breathing and Its Basic Principles

A basic pranayama practice may involve three major components of respiration: inhalation (*puraka*), exhalation (*rechaka*), and breath retention (*kumbhaka*). Breath retention may occur after inhalation (*antara kumbhaka*) or after exhalation (*bahya kumbhaka*). However, not every pranayama technique uses all these components, and their duration and intensity differ according to the particular practice. Therefore, pranayama represents a broad group of breathing techniques rather than a single standardized exercise (*Jayawardena et al., 2020*). Different yogic breathing techniques use different methods of controlling

respiration. **Nadi Shodhana** involves alternate-nostril breathing, while **Ujjayi** is characterized by controlled breathing with partial narrowing of the glottic passage. **Bhramari** combines controlled breathing with a humming sound during exhalation, whereas **Bhastrika** involves relatively forceful inhalation and exhalation. Other practices, such as Sheetali and Sheetkari, modify the method of inhalation. These variations create different respiratory patterns and may therefore produce different physiological responses (*Novaes et al., 2020*). Another important principle of yogic breathing is the development of **awareness and control over respiration**. Practitioners are generally encouraged to maintain a steady and coordinated breathing pattern rather than breathing automatically or irregularly. Slow breathing practices particularly emphasize prolonged, controlled respiration, whereas more dynamic techniques may involve faster or more forceful respiratory movements. Recent evidence also indicates that pranayama techniques differ considerably in their breathing rate, nostril manipulation, sound production, and use of breath retention, which should be considered when interpreting their physiological effects (*Kesar & Nathani, 2025*).

Physiological Mechanisms of Yogic Breathing

The physiological effects of yogic breathing are thought to arise from the close interaction between respiration, the nervous system, and cardiovascular regulation. Unlike spontaneous breathing, pranayama involves deliberate changes in respiratory rate, depth, rhythm, and sometimes breath retention. These changes provide sensory signals from the respiratory system to the brain and may influence the regulation of both breathing and autonomic activity (*Jerath et al., 2006*).

- **Mechanical stimulation of the respiratory system:-** During slow and deep breathing, greater movement of the diaphragm and expansion of the lungs stimulate stretch-sensitive receptors located within the respiratory tract and lung tissue. These receptors transmit information to respiratory centres in the brainstem and may contribute to the adjustment of breathing patterns. Slow breathing may therefore increase awareness and control of respiration while modifying the normal interaction between respiratory and neural activity (*Jerath et al., 2006*). The respiratory centres of the medulla and pons coordinate the timing and pattern of breathing, allowing voluntary breathing practices to interact with normally automatic respiratory control (*Zaccaro et al., 2018*).
- **Respiratory–autonomic interaction:-** Breathing and cardiovascular activity are closely linked through respiratory sinus arrhythmia, in which heart rate normally increases during inspiration and decreases during expiration. Slow breathing can strengthen this respiratory–cardiac interaction and may increase vagally mediated cardiovascular variability. Research on slow breathing has shown effects on heart rate variability, baroreflex sensitivity, blood pressure regulation, and sympathovagal balance (*Russo et al., 2017*). In yoga practitioners, slow breathing has also been associated with differences in baroreflex sensitivity and cardiovascular variability compared with individuals without regular yoga practice (*Sankhla et al., 2021*).
- **Vagus nerve:** The vagus nerve may provide another important connection between controlled respiration and autonomic regulation. Slow, rhythmic breathing can increase the influence of vagal activity on the heart, particularly when breathing occurs at a relatively slow frequency. This may contribute to increased heart rate variability and improved short-term cardiovascular regulation. However, the evidence is not completely consistent. For example, a pilot study of long-term yoga practitioners found greater respiratory sinus arrhythmia during spontaneous breathing, but no clear

difference between practitioners and controls during paced breathing, suggesting that the apparent autonomic effects may partly depend on the breathing condition itself (Tyagi *et al.*, 2017).

- **Nasal route of breathing:-** The nasal route of breathing may also contribute to some effects of specific pranayama practices. Nasal breathing is associated with the production and transport of nitric oxide from the nasal passages. Nitric oxide has physiological roles including vasodilation and modulation of airway function. Experimental research examining unilateral nostril breathing has investigated whether changes in nasal airflow can influence inhaled nasopharyngeal nitric oxide concentrations, providing a possible pathway through which nostril-regulated breathing could affect respiratory and vascular physiology (Mordecai *et al.*, 2021).

Overall, yogic breathing appears to involve several interconnected physiological pathways rather than a single mechanism. Controlled respiratory movements may influence pulmonary stretch receptors, brainstem respiratory regulation, vagal activity, respiratory–cardiac coupling, and baroreflex function. These mechanisms may work together to produce changes in respiratory efficiency and autonomic regulation. Nevertheless, some proposed pathways remain theoretical or require further experimental confirmation, and the physiological response may vary according to the specific pranayama technique, breathing rate, duration, and use of breath retention.

Respiratory Adaptations Associated with Yogic Breathing

Regular practice of yogic breathing may lead to gradual adaptations in the respiratory system by repeatedly challenging the muscles and physiological processes involved in breathing. These adaptations are generally reflected in changes in pulmonary function, respiratory muscle performance, and the ability to regulate breathing efficiently. The available evidence suggests that the extent of these changes may depend on the type of breathing practice, duration of training, and characteristics of the individual.

One of the most frequently reported adaptations is an improvement in lung volumes and ventilatory capacity. Parameters such as forced vital capacity (FVC), forced expiratory volume in one second (FEV₁), and maximum voluntary ventilation (MVV) have been investigated in individuals practicing yoga and pranayama. A systematic review and meta-analysis reported significant improvements in several pulmonary-function measures, including FVC, FEV₁, FEV₁/FVC, PEFR, and respiratory muscle strength parameters such as maximum inspiratory and expiratory pressure following yogic interventions (Bhagel & Saha, 2021). Earlier evidence also suggested that regular yoga practice of approximately 10 weeks or longer may improve several pulmonary-function measures in healthy individuals, although the magnitude of improvement may vary with the duration and intensity of pranayama practice (Abel *et al.*, 2013).

- **Expiratory airflow:-** Expiratory airflow may also show improvement following regular yogic breathing. Peak expiratory flow rate (PEFR) reflects the ability to generate rapid expiratory airflow and is therefore an important indicator of airway and ventilatory performance. In a randomized controlled trial, 12 weeks of both slow and fast pranayama produced improvements in selected pulmonary-function parameters, with PEFR showing significant improvement in both pranayama groups (Dinesh *et al.*, 2015). These findings suggest that different breathing patterns may produce respiratory adaptations even though the exact pattern of change may differ between slow and fast practices.
- **Respiratory muscle performance:** Another important adaptation concerns respiratory muscle performance. Repeated controlled breathing may increase the functional demand placed on the diaphragm and other respiratory muscles, particularly when deep breathing or forceful expiration is

involved. Evidence from healthy adults indicates that yogic interventions can improve maximum inspiratory and expiratory pressures, suggesting better respiratory muscle strength (Bhagel & Saha, 2021). Similarly, an eight-week yoga program in healthy inactive middle-aged individuals reported improvement in respiratory function, with the inclusion of pranayama providing additional benefit for inspiratory muscle strength (Tran et al., 2019).

Technique-specific studies provide further evidence for respiratory adaptation. For example, one-month practice of **Bhastrika pranayama** was associated with significant improvements in FVC, FEV₁, PEFr, and MVV in healthy young adults. The magnitude of improvement was greater than that observed with the running intervention used for comparison in the same study (Budhi et al., 2019). In another study, Bhramari pranayama combined with Om chanting produced improvements in selected measures including slow vital capacity, FEV₁, PEFr, and MVV after two weeks of practice (Moovenathan & Khode, 2014).

Clinical Implications for Respiratory Health

The potential clinical importance of yogic breathing lies in its ability to provide a simple, non-pharmacological approach that may be used alongside conventional respiratory care. Because many yogic breathing practices involve slow, controlled, and conscious respiration, they may help individuals develop better breathing control and may contribute to improvements in selected respiratory outcomes. However, yogic breathing should be considered a **complementary approach rather than a replacement for prescribed medical treatment**.

One of the most studied clinical applications of yogic breathing is **bronchial asthma**. Asthma is characterized by variable airway obstruction, respiratory symptoms, and airway hyperresponsiveness. Controlled breathing practices may help patients regulate their breathing pattern and may contribute to improved pulmonary function and symptom management. A randomized controlled trial reported that a pranayama-based intervention improved asthma control and quality of life, although the changes in pulmonary-function parameters were not consistently significant between groups (Yüce & Taşcı, 2020). Another clinical trial involving patients with asthma found that high-frequency yoga breathing produced improvements in selected pulmonary-function measures, suggesting that specific breathing practices may have therapeutic potential in respiratory rehabilitation (Raghavendra et al., 2016). The clinical relevance of yoga has also been examined in **children and adolescents with asthma**. A recent systematic review and meta-analysis of randomized controlled trials found that yoga-based interventions used alongside standard pharmacological treatment improved several pulmonary-function parameters, including FVC%, FEV₁%, FEV₁/FVC%, and PEFr% at selected follow-up periods. However, improvements in asthma control and quality of life were not consistently demonstrated, indicating that pulmonary benefits do not necessarily translate into improvement in every clinical outcome (Yadav et al., 2026). This finding highlights the importance of evaluating respiratory function and patient-centred outcomes separately.

Another potential application is **chronic obstructive pulmonary disease (COPD)**. Patients with COPD frequently experience breathlessness, reduced exercise tolerance, and impaired quality of life. Yoga-based breathing practices may assist with breathing control and may be incorporated into broader respiratory rehabilitation programs. A systematic review and meta-analysis of yoga training in COPD reported potential improvements in pulmonary function and functional capacity, although the number of available trials was limited and considerable variation existed between interventions (Liu et al., 2014). Thus, yogic breathing may have value as an adjunct to conventional pulmonary rehabilitation, but stronger evidence is required before it can be considered a standardized clinical intervention.

Clinical evidence also suggests that the benefits of yogic breathing may extend beyond spirometric measurements. Improvements in **symptom control, quality of life, and functional well-being** are clinically important because respiratory diseases can affect daily activities even when changes in lung-function tests are relatively small. For example, yoga-based intervention in adults with asthma has been associated with improvements in respiratory function, symptom control, and asthma-related quality of life (*Turan & Tan, 2019*). These findings suggest that the potential clinical value of yogic breathing should be assessed using both objective respiratory measurements and patient-reported outcomes. At the same time, the evidence should be interpreted cautiously. Earlier systematic reviews of yoga for asthma reported inconsistent findings and highlighted methodological limitations among available trials (*Posadzki & Ernst, 2011*). More recent evidence is generally more encouraging, but heterogeneity in yoga techniques, treatment duration, participant characteristics, and outcome measures remains a major limitation. Therefore, yogic breathing may reasonably be considered a **supportive component of respiratory health management**, particularly when practiced under appropriate guidance and alongside standard medical care. Future clinical trials should use standardized breathing protocols, adequate sample sizes, longer follow-up periods, and clinically meaningful outcomes to establish its long-term effectiveness.

Table 1: Evidence from recent research

Year	Author(s)	Study Population	Yogic Breathing Intervention	Main Outcomes	Key Findings
2026	Agrawal et al.	Young, stable COPD patients	Yoga intervention including breathing practices	FVC, FEV ₁ , PEFR and other pulmonary parameters	Yoga intervention was associated with improvement in selected pulmonary-function measures, suggesting potential value as an adjunct in stable COPD.
2026	Saravanakumar & Mohanakrishnan	Women with asthma	Neuromuscular breathing exercise with yogic practices	FEV ₁ , PEFR, FVC, asthma control	Sixteen weeks of practice produced significant improvements in pulmonary function and asthma control compared with controls.
2026	Roj et al.	Men with opioid dependence	Breath-centred yoga including pranayama, yoga-linked breathing and relaxation	FVC, FEV ₁ , PEFR, estimated lung age	Significant improvements were observed in FVC, FEV ₁ and PEFR after one month,

					with a reduction in estimated lung age.
2025	Rathore et al.	Clinical populations with respiratory conditions	Yoga-based interventions	FVC, FEV ₁ , FEV ₁ %, PEFR, MVV	Meta-analysis showed significant improvements in FVC%, FEV ₁ and FEV ₁ %, although effects on PEFR, MVV and some other parameters were not significant.
2025	Rohini et al.	Post-COVID patients	Bhramari and Sheetal Pranayama	Pulmonary function and cardiorespiratory measures	The study reported improvements in selected pulmonary and cardiorespiratory outcomes following pranayama practice.
2023	Sangeethalaxmi & Hankey	Young adults with bronchial asthma	Yogic breathing and relaxation	Pulmonary function, quality of life, anxiety and depression	Yogic breathing combined with relaxation improved pulmonary function and several psychological and quality-of-life outcomes.
2017	Kaminsky et al.	Adults with moderate-to-severe COPD	Pranayama	Exercise tolerance and pulmonary outcomes	Pranayama showed potential benefits in respiratory and exercise-related outcomes, although the magnitude of improvement was limited.
2017	Hakked et al.	Competitive young swimmers	Sectional breathing, Bhastrika and Nadi Shodhana	FVC, MVV and respiratory performance	Yogic breathing practices improved selected pulmonary-function measures, suggesting

					enhanced respiratory capacity in trained swimmers.
2014	Gupta et al.	Patients with COPD	Pranayama	Respiratory rate, vital capacity, MVV, MIP, MEP	Pranayama used alongside conventional care showed beneficial changes in respiratory function and respiratory-muscle performance.
2003	Madanmohan et al.	School children	Yoga training including pranayama	FEV ₁ , PEF, respiratory pressures	Long-term yoga training improved selected pulmonary-function parameters and respiratory muscle pressures.

The studies summarized above indicate that yogic breathing may have a positive but variable influence on respiratory function. Improvements have been reported in parameters such as FVC, FEV₁, PEF, MVV, and respiratory muscle performance, with benefits observed in both healthy individuals and clinical populations. Recent evidence is particularly encouraging in conditions such as asthma and COPD, where yogic breathing has been investigated as an adjunct to conventional management. Overall, the available research supports yogic breathing as a promising complementary approach for maintaining and improving respiratory function, while further standardized and long-term clinical trials are needed to establish its precise therapeutic role.

Discussion

The present narrative review indicates that yogic breathing practices may positively influence respiratory function through a combination of mechanical, neuromuscular, autonomic, and behavioral mechanisms. Across the reviewed literature, improvements have been reported in pulmonary function parameters such as forced vital capacity (FVC), forced expiratory volume in one second (FEV₁), peak expiratory flow rate (PEFR), maximal voluntary ventilation (MVV), and respiratory muscle strength. These findings suggest that controlled breathing may improve ventilatory efficiency and respiratory muscle performance, particularly when practiced regularly. The evidence also indicates that the effects of yogic breathing are not uniform and may vary according to the specific technique, duration of practice, participant characteristics, and clinical condition. Slow breathing practices may be particularly relevant for autonomic regulation and breathing control, whereas more active techniques may produce greater ventilatory stimulation. In clinical populations, including individuals with asthma and chronic obstructive pulmonary disease, yoga-based breathing practices have shown potential benefits as an adjunct to conventional

management. However, differences in study design, intervention protocols, sample sizes, and outcome measures limit direct comparison between studies.

Overall, yogic breathing appears to be a promising, low-cost, and relatively accessible supportive approach for maintaining respiratory health and improving selected aspects of pulmonary function. Nevertheless, it should be considered complementary rather than a replacement for established medical treatment. Further well-designed randomized controlled trials with standardized breathing protocols, longer follow-up periods, and clinically relevant respiratory outcomes are needed to establish its effectiveness and clarify the underlying physiological mechanisms.

Conclusion

Yogic breathing practices appear to have beneficial effects on respiratory function through improvements in breathing efficiency, respiratory muscle performance, and autonomic regulation. Available evidence suggests that regular practice may improve selected pulmonary function parameters and provide supportive benefits in individuals with respiratory disorders such as asthma and chronic obstructive pulmonary disease. However, variations in techniques, duration, and study methodology limit definitive conclusions. Yogic breathing may therefore be considered a useful complementary approach to conventional respiratory care, while further well-designed studies are required to establish standardized protocols and long-term clinical benefits.

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