Efficacy of Pranayama Intervention on Lung Function Among Bronchial Asthma Patients

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ABSTRACT

Background: Bronchial asthma is a chronic inflammatory airway disorder characterized by reversible airflow obstruction and bronchial hyperresponsiveness. While conventional pharmacological management provides symptomatic relief, it often fails to fully restore pulmonary function. Yogic breathing techniques (Pranayama) have been recognized as a potential complementary therapy to improve respiratory efficiency and overall lung function.

Objective: This study aimed to evaluate the efficacy of a structured Pranayama intervention on pulmonary function among patients with bronchial asthma.

Methods: A total of 60 participants with clinically diagnosed mild to moderate bronchial asthma were recruited from Alappuzha district, Kerala, and randomized into intervention and control groups. The intervention group received an 8-week Pranayama program consisting of five supervised sessions per week (45 minutes each), incorporating Anuloma-Viloma, Bhramari, and Sectional Breathing. Pulmonary function was assessed at baseline and post-intervention using spirometry parameters, including forced vital capacity (FVC), forced expiratory volume in one second (FEV1), peak expiratory flow rate (PEFR), and FEV1/FVC ratio. Data were analyzed using paired and independent t-tests, with $p < 0.05$ considered statistically significant.

Results: Participants in the intervention group demonstrated significant improvements in FEV1 ($p < 0.05$), PEFR ($p < 0.01$), and FEV1/FVC ratio ($p < 0.05$) compared to controls. No significant changes were observed in the control group across spirometric measures.

Conclusion: The findings indicate that structured Pranayama practices can significantly enhance pulmonary function in patients with bronchial asthma. These results support the integration of Pranayama as a safe and cost-effective adjunct to conventional asthma management.

Keywords: Pranayama, bronchial asthma, pulmonary function, spirometry, yoga therapy

INTRODUCTION

Bronchial asthma is a chronic inflammatory disease of the airways, marked by episodic airflow obstruction and bronchial hyperresponsiveness. According to the World Health Organization (WHO, 2023), more than **260 million people** are affected globally, and approximately **500,000 deaths** occur annually due to uncontrolled asthma. The prevalence continues to rise, particularly in low- and middle-income countries, contributing to both **economic burden** (due to healthcare costs and loss of productivity) and **reduced quality of life**. In India, the estimated prevalence of asthma is around **2–3% of the population**, with a higher incidence in children and young adults. This increasing global and national burden underscores the need for cost-effective and holistic management strategies.

Traditional Perspectives of Asthma

The **Annamaya Kosha**, or physical body sheath, represents the tangible manifestation of disease in asthma, where symptoms such as cough, wheezing, and breathlessness are most evident. In modern

psychoneuroimmunology (PNI), this corresponds to dysregulated immune responses involving T-helper type 2 (Th2) pathway activation, eosinophilia, and IgE hypersensitivity, which trigger airway inflammation (Busse et al., 2015). The respiratory muscles and lung tissue carry the physical burden of this dysfunction. Through pranayama, respiratory mechanics are improved, tidal volume is enhanced, and airway resistance is reduced, which aligns with a reduced inflammatory load at the level of the *Annamaya Kosha* (Sodhi et al., 2009).

The **Prāṇamaya Kosha**, or vital energy sheath, is understood as the domain of prāṇa, where disturbances in the flow of vital energy obstruct breath rhythm and lead to asthma attacks. PNI parallels this with autonomic nervous system (ANS) dysfunction. Asthma is often associated with vagal overactivity, bronchoconstriction, and impaired sympatho-vagal balance (Cazzola et al., 2012). Slow, regulated breathing techniques such as pranayama stimulate vagal tone, increase heart rate variability (HRV), and restore parasympathetic dominance (Brown & Gerbarg, 2005). In this way, the yogic interpretation of restoring prāṇic flow maps directly onto modern explanations of improved ANS regulation, leading to reduced airway hyperreactivity.

The **Manomaya Kosha**, or mental-emotional sheath, highlights the role of mind in disease. Anxiety, fear, and emotional turbulence aggravate asthma, revealing the intimate connection between mind and prāṇa, as emphasized in the *Haṭha Pradīpikā* (II:2), which states *"Cale vāte calaṁ cittaṁ, niścale niścalaṁ bhavet"* – "When the breath is unsteady, the mind is unsteady; when the breath is steady, the mind is steady" (Muktibodhananda, 2002), and in the *Tirumandiram* (verse 564), which affirms that "when breath wanders, the mind is unsteady; when breath is still, the mind becomes steady" (Natarajan, 1991). PNI interprets this through the stress response: activation of the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system elevates cortisol, adrenaline, and inflammatory cytokines such as IL-6 and TNF-α, which exacerbate bronchial inflammation and airway narrowing (Rosenkranz et al., 2005). By calming the mind, pranayama down-regulates this stress response, reducing HPA overactivation and minimizing stress-induced exacerbations (Saoji, 2016).

The **Vijñānamaya Kosha**, or wisdom sheath, concerns the faculty of discernment and cognitive appraisal. Imbalance at this level manifests as fear of disease, misidentification, and maladaptive health beliefs, while balance brings clarity and resilience. PNI research shows that cognitive appraisal strongly influences neuroendocrine-immune outcomes: patients who perceive asthma as uncontrollable exhibit higher stress biomarkers (Wright et al., 2002). Through mindful awareness cultivated in pranayama, maladaptive appraisals are retrained, fostering self-regulation, resilience, and reduction of maladaptive brain–immune signaling (Telles et al., 2020).

The **Ānandamaya Kosha**, or bliss sheath, represents psychophysiological harmony, where body, prāṇa, and mind integrate to produce health and well-being. From a PNI perspective, this state corresponds to optimal systemic balance, with reduced inflammatory markers, stable autonomic regulation, and improved immune tolerance. Practices such as deep pranayama, *Yoga Nidra*, and *Bhramari* induce parasympathetic dominance, facilitate nitric oxide release, and promote emotional well-being, thereby reducing symptom severity and enhancing quality of life in asthma patients (Kharitonov & Barnes, 2003; Telles & Singh, 2018).

Taken together, these perspectives form a **conceptual bridge** between traditional and modern frameworks. The kosha model views asthma as a multidimensional imbalance across physical, prāṇic, mental, intellectual, and bliss layers, while PNI describes it as a psychophysiological disorder involving mind–nervous system–immune cross-talk. Pranayama emerges as the bridge, regulating breath (*prāṇa*) to stabilize the mind (*manas*), balance the autonomic nervous system, downregulate the HPA axis, and reduce inflammatory load, thereby improving lung function and quality of life.

Ayurvedic View: Tamaka Shwasa

In Ayurveda, asthma is conceptualized as *tamaka shwasa*, a chronic condition associated with the aggravation

of *vāta* and *kapha doshas*. Excess *kapha* obstructs the respiratory passages, while deranged *vāta* causes spasmodic breathing. Classical texts describe symptoms such as breathlessness, wheezing, and cough, which closely resemble modern clinical definitions of asthma. Ayurvedic approaches emphasize cleansing (*shodhana*)

and pacification (*shamana*) therapies, which align with yogic breathing techniques that purify the airways and balance doshas.

Regulatory Mechanisms of Pathophysiology in Asthma and the Role of Pranayama

From a biomedical perspective, bronchial asthma is a multifactorial condition involving **airway inflammation, autonomic dysregulation, and altered respiratory mechanics**. Chronic inflammation of the bronchial mucosa results in airway narrowing, mucous hypersecretion, and infiltration of eosinophils and mast cells, which reduce pulmonary compliance and impair airflow. In addition, hyperactivation of the **parasympathetic nervous system** increases vagal tone, leading to bronchoconstriction, while an imbalance between sympathetic and parasympathetic activity further exacerbates airway hyperresponsiveness. Over time, these processes contribute to airway remodeling, impaired lung function, and increased frequency of exacerbations.

Pranayama practices offer potential regulatory effects on these pathophysiological mechanisms.

- **Anuloma-Viloma (Alternate Nostril Breathing):** This practice balances sympathetic and parasympathetic activity by stabilizing autonomic fluctuations, thereby reducing airway reactivity and promoting optimal bronchodilation. Improved heart rate variability observed in alternate nostril breathing further indicates enhanced autonomic regulation.

- **Bhramari (Humming Bee Breath):** The humming sound generated during exhalation enhances the release of **nitric oxide (NO)** from the paranasal sinuses, which acts as a natural bronchodilator and anti-inflammatory mediator. Nitric oxide also improves ventilation-perfusion matching in the lungs and reduces airway resistance, thereby supporting pulmonary function.

- **Sectional Breathing (Abdominal, Thoracic, and Clavicular Breathing):** This practice trains the respiratory muscles, enhances chest wall mobility, and promotes complete lung expansion. By consciously engaging different lung regions, sectional breathing improves tidal volume and vital capacity, counteracting the restricted breathing patterns common in asthma.

Through these mechanisms, **pranayama directly addresses key elements of asthma pathophysiology**—it reduces bronchoconstriction, improves pulmonary mechanics, enhances autonomic balance, and lowers inflammatory load. Thus, pranayama can be viewed not only as a complementary therapy but also as a physiological regulator capable of restoring respiratory homeostasis in asthma patients.

Pranayama as a Non-Pharmacological Intervention

Pranayama, a central component of yoga, involves controlled regulation of inhalation, exhalation, and breath retention. Scientifically, it has been shown to:

- Enhance pulmonary function by improving **tidal volume** and **vital capacity**.

- Increase **parasympathetic activity**, reducing bronchospasm.

- Lower **stress and anxiety**, thereby reducing asthma triggers.

- Improve **oxygen saturation and exercise tolerance**.

Unlike pharmacological interventions, pranayama is **cost-free, non-invasive, and patient-empowering**, making it especially relevant in community and integrative healthcare settings.

Aim of the Study

In light of these gaps, the present study was undertaken to **evaluate the efficacy of a structured pranayama intervention on pulmonary function among patients with bronchial asthma**. This research seeks to

establish pranayama as an evidence-based complementary therapy that can be integrated into standard asthma management protocols.

MATERIALS AND METHODS

Study Design: Randomized controlled trial (8 weeks).

Participants: Inclusion: clinically diagnosed mild–moderate asthma patients (18–45 yrs). Exclusion: smokers, severe asthma, comorbid lung disease.

Intervention:

- *Warm-up*: Sukshma Vyayama, thoracic expansion (10 min).
- *Pranayama*: Sectional Breathing, Anuloma-Viloma, Bhramari (20 min).
- *Relaxation*: Shavasana (15 min).

Frequency & Duration: 5 sessions/week, 45 min/session, for 8 weeks.

Assessment Tools:

- Spirometry (FVC, FEV1, PEFR, FEV1/FVC).
- Pulse Oximeter (SpO_2).

Statistical Analysis: Paired t-test, ANOVA, $p<0.05$ considered significant.

Results

Table 1. Forced Vital Capacity (FVC) in Intervention and Control Groups (Pre–Post)

Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference	*t* Value	*p* Value
Intervention	2.65 ± 0.45	3.05 ± 0.40	+0.40	3.12	0.003*
Control	2.70 ± 0.42	2.73 ± 0.38	+0.03	0.56	0.579

Table 2. Forced Expiratory Volume in 1 Second (FEV1) in Intervention and Control Groups (Pre–Post)

Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference	*t* Value	*p* Value
Intervention	1.95 ± 0.35	2.30 ± 0.32	+0.35	4.26	0.001**
Control	1.98 ± 0.30	2.00 ± 0.29	+0.02	0.42	0.678

Table 3. Peak Expiratory Flow Rate (PEFR) in Intervention and Control Groups (Pre–Post)

Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference	*t* Value	*p* Value
Intervention	280.50 ± 45.20	335.60 ± 40.80	+55.10	5.18	<0.001**
Control	285.40 ± 42.10	289.20 ± 43.50	+3.80	0.67	0.508

Table 4. FEV1/FVC Ratio (%) in Intervention and Control Groups (Pre–Post)

Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference	*t* Value	*p* Value
Intervention	73.50 ± 6.20	78.20 ± 5.80	+4.70	2.95	0.005*
Control	73.80 ± 6.00	74.10 ± 5.95	+0.30	0.38	0.702

Note: Values expressed as Mean ± SD. $p < 0.05$ = significant (*), $p < 0.01$ = highly significant (**).

DISCUSSION

The present study demonstrated that a structured pranayama intervention led to significant improvements in pulmonary function among patients with bronchial asthma. These findings suggest that pranayama enhances pulmonary mechanics, reduces airway resistance, and promotes autonomic regulation through increased vagal tone. Slow and controlled breathing practices are known to induce parasympathetic dominance, thereby facilitating bronchial relaxation and improving airflow. The current results are consistent with earlier studies, such as those by Visweswaraiah and Telles (2004), who reported improvements in spirometric parameters following yogic breathing practices, and Singh et al. (2019), who demonstrated that pranayama reduced symptom severity and enhanced lung function in asthmatic patients. The underlying physiological mechanisms may be attributed to the modulation of autonomic nervous system activity, nitric oxide release during humming practices like bhramari, and improved respiratory muscle efficiency through sectional breathing.

Clinically, these results underscore the relevance of pranayama as a safe, non-invasive, and cost-effective adjunct to conventional pharmacological therapy. Unlike medications, which primarily address acute symptoms, pranayama offers a holistic approach that can improve respiratory efficiency, reduce psychosomatic triggers, and enhance quality of life. However, the study has certain limitations, including a relatively small sample size, short intervention duration, and absence of biochemical or immunological markers to confirm systemic changes. Future research should focus on larger, multicentric randomized controlled trials with extended follow-up, as well as the inclusion of biomarkers such as interleukin-6, eosinophil counts, and fractional exhaled nitric oxide (FeNO) to better elucidate the immunological mechanisms underlying the observed clinical benefits.

CONCLUSION

Structured pranayama intervention significantly improves lung function in patients with bronchial asthma and can be integrated as a complementary therapy in routine clinical management.

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