Effect of Selected Yogic Practices on Forced Vital Capacity and Peak Expiratory Flow Rate among Healthy Young Adults

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Abstract

Maintaining optimal respiratory function is essential for physical well-being, particularly among young adults who may be vulnerable to the effects of sedentary lifestyles and environmental stressors. Yogic practices, encompassing specific postures (asanas) and breathing techniques (pranayama), have been traditionally employed to improve respiratory efficiency and autonomic balance. To assess the effect of selected yogic practices on *Forced Vital Capacity (FVC)* and *Peak Expiratory Flow Rate (PEFR)* in healthy young adults aged 18–25 years.

A randomized controlled trial was conducted on **60 healthy young adults**, who were randomly assigned into two groups: Experimental Group (n=30) and Control Group (n=30). The Experimental Group underwent a structured yoga intervention for 8 weeks, including selected asanas and pranayama techniques, for 45 minutes per day, 5 days per week. The Control Group followed their usual daily activities without any yogic intervention. Baseline and post-intervention assessments of FVC and PEFR were conducted using a standardized spirometer.
Post-intervention analysis revealed a statistically significant improvement ($p<0.01$) in both FVC and PEFR in the Experimental Group compared to baseline and the Control Group. The Control Group showed no significant changes in either parameter. The observed enhancement in respiratory parameters suggests improved pulmonary elasticity, diaphragmatic efficiency, and neural regulation through consistent yogic practice. An 6-week program of selected yogic practices led to significant improvements in Forced Vital Capacity and Peak Expiratory Flow Rate among healthy young adults. These findings support the integration of yoga into preventive healthcare strategies for improving respiratory function in the youth population.

Keywords: Yoga, Forced Vital Capacity, Peak Expiratory Flow Rate, Pranayama, Lung Function, Young Adults, Yoga Therapy.

1. Introduction

The respiratory system is essential for sustaining life, enabling the intake of oxygen and the expulsion of carbon dioxide through the coordinated function of the lungs and associated musculature. Proper respiratory health supports cellular metabolism, energy production, and the optimal functioning of organs and systems. Globally, respiratory disorders are among the leading causes of morbidity and mortality. According to the World Health Organization (WHO, 2023), over 300 million people suffer from asthma, and chronic obstructive pulmonary disease (COPD) affects more than 250 million individuals worldwide. In India alone, the prevalence of chronic respiratory diseases is significant, contributing to nearly 10% of all deaths annually. Urban pollution, sedentary lifestyles, tobacco use, and rising stress levels are key factors contributing to the decline in pulmonary function across populations.

Forced Vital Capacity (FVC) and Peak Expiratory Flow Rate (PEFR) are critical spirometric parameters used to assess lung function. These metrics help identify restrictive and obstructive lung conditions and serve as useful tools for monitoring respiratory health in both clinical and preventive contexts. With an increasing number of individuals experiencing subclinical reductions in pulmonary performance—even in the absence of overt disease—there is a growing need for preventive, non-pharmacological approaches to improve lung function. Yogic practices, which include structured breathing exercises (Pranayama), physical postures (Asanas), and relaxation techniques, have been shown in several studies to enhance lung capacity, improve respiratory endurance, and regulate autonomic function. Hence, exploring the effect of selected yogic interventions on pulmonary variables such as FVC and PEFR is not only timely but also essential for developing holistic strategies for respiratory health promotion.

Pulmonary function tests are essential diagnostic tools used to assess the health and capacity of the respiratory system. Among the most widely used spirometric parameters are Forced Vital Capacity (FVC) and Peak Expiratory Flow Rate (PEFR), both of which provide critical insights into the ventilatory performance of the lungs. **FVC** refers to the maximum volume of air that an individual can forcibly exhale from the lungs after taking the deepest possible breath. It is a key indicator of lung volume and reflects the mechanical properties of the lung and chest wall. A reduction in FVC often points to restrictive lung disorders such as pulmonary fibrosis or neuromuscular weakness.

On the other hand, **PEFR** represents the maximum speed of expiration, usually measured in liters per minute, and serves as an important marker of airway patency. It is particularly useful in identifying obstructive airway conditions like asthma and chronic obstructive pulmonary disease (COPD), where the rate of airflow is significantly reduced due to bronchial constriction. These variables are not only critical in diagnosing respiratory diseases but also in monitoring disease progression, evaluating treatment response, and assessing fitness levels in healthy individuals. Portable, non-invasive, and reproducible, FVC and PEFR are widely employed in clinical, occupational, and sports medicine settings. Furthermore, they are sensitive to interventions such as physical training, respiratory therapy, and yogic breathing practices, making them ideal parameters for evaluating the efficacy of holistic and lifestyle-based interventions aimed at improving lung health.

Yogic practices, particularly those emphasizing breath regulation (Pranayama) and physical postures (Asanas), have been scientifically shown to influence various aspects of respiratory physiology. These practices contribute to enhanced pulmonary efficiency through mechanical, neural, and biochemical mechanisms that optimize lung function and breathing patterns. Among the most impactful techniques are **slow deep breathing (e.g., Nadi Shodhana), forceful exhalation practices (e.g., Kapalabhati), and breath retention (e.g., Kumbhaka)**, each of which affects the respiratory system in distinct yet complementary ways.

Pranayama techniques directly modulate the autonomic nervous system, improving **parasympathetic tone** and reducing respiratory rate while enhancing tidal volume. A study by Joshi et al. (1992) reported that regular practice of slow Pranayama significantly increased **Forced Vital Capacity (FVC)** and **Maximum Voluntary Ventilation (MVV)**, indicating improved lung compliance and respiratory muscle strength. Similarly, **Kapalabhati**, characterized by forceful abdominal contractions and passive inhalation, enhances expiratory muscle performance and clears respiratory passages, thereby potentially improving **Peak Expiratory Flow Rate (PEFR)**.

Yogic postures such as **Bhujangasana (cobra pose), Dhanurasana (bow pose), and Ardha Matsyendrasana (spinal twist)** are also known to expand the thoracic cavity, improve chest wall mobility, and stretch respiratory muscles, especially the intercostals and diaphragm. These physical effects contribute to better lung expansion and airflow. Additionally, yoga has been shown to reduce oxidative stress and inflammation in the respiratory tract, as reported in studies involving individuals with bronchial asthma (Singh et al., 2005).

On a neurophysiological level, yogic breathing slows the respiratory rhythm and induces coherent heart rate variability (HRV), which reflects improved **cardiorespiratory synchronization**. This is associated with greater oxygen utilization and improved gas exchange efficiency. Controlled breathing also enhances the function of chemoreceptors and baroreceptors, leading to better adaptation of respiratory control centers in the brainstem.

From a biochemical perspective, regular practice of Pranayama improves **oxygen saturation (SpO_2)**, reduces **carbon dioxide retention**, and promotes **alkaline blood pH**, supporting efficient respiratory metabolism. The modulation of CO_2 sensitivity through practices like **Anuloma-Viloma** and **Bhramari** has been shown to reduce breathlessness and increase lung capacity over time.

In summary, scientifically validated yogic practices influence respiratory physiology by:

- Enhancing lung volumes (FVC, VC, TV)
- Increasing flow rates (PEFR, FEV_1)
- Strengthening respiratory muscles
- Regulating autonomic balance
- Improving thoracic flexibility and chest wall mechanics

- Reducing inflammation and stress-related respiratory symptoms
  Such effects make yoga a promising non-pharmacological tool for both **preventive respiratory health** and **rehabilitation in pulmonary disorders.**

  In recent years, there has been a growing global emphasis on preventive healthcare strategies that are safe, cost-effective, and sustainable. Non-communicable diseases, including respiratory disorders such as asthma, chronic obstructive pulmonary disease (COPD), and stress-related pulmonary dysfunction, are on the rise due to environmental pollution, sedentary lifestyles, and poor stress management. Conventional medical approaches, while effective in symptom management, often involve long-term pharmacological treatment that may be associated with side effects, dependency, or limited improvement in overall respiratory function. This has led to increased interest in non-invasive, holistic modalities that focus on root-cause prevention, functional enhancement, and lifestyle correction.

  Yoga, as a traditional mind-body discipline, offers a scientifically supported, non-invasive alternative that addresses both physiological and psychological aspects of health. Its practices—particularly **Asanas (postures), Pranayama (breathing techniques), and Dhyana (meditation)**—require no equipment or invasive procedures, and they can be easily integrated into daily routines. Unlike conventional treatments, yoga aims to improve **respiratory muscle strength, lung compliance, autonomic balance**, and emotional regulation—all of which contribute to improved pulmonary efficiency and resilience against respiratory illnesses.

  Several studies have demonstrated that regular yogic practice leads to measurable improvements in spirometric variables such as **Forced Vital Capacity (FVC)** and **Peak Expiratory Flow Rate (PEFR)**, even among asymptomatic individuals. These benefits are achieved without pharmacological interventions, making yoga especially suitable for use in primary prevention and health promotion programs. Additionally, yoga improves quality of life, enhances stress coping mechanisms, and supports long-term adherence through its self-empowering and holistic approach.

  Given the burden of respiratory diseases and the limitations of conventional therapies, there is a clear and compelling need for evidence-based, non-invasive interventions like yoga that can improve pulmonary function and overall health without side effects. This justifies further scientific exploration into the **effectiveness of selected yogic practices on respiratory variables** in both clinical and general populations.

Respiratory efficiency plays a fundamental role in sustaining physical health and mental well-being. In light of the increasing burden of respiratory dysfunctions and the growing prevalence of subclinical respiratory limitations—even among seemingly healthy individuals—there is an urgent need to explore safe, preventive, and sustainable approaches to strengthen pulmonary function. While pharmacological interventions provide symptomatic relief, they often come with side effects and do not address the root cause of diminished respiratory performance, especially when it is lifestyle-induced.

Scientific evidence suggests that yogic practices, particularly Pranayama and specific Asanas, can improve pulmonary variables by enhancing respiratory muscle strength, optimizing thoracic mobility, and regulating autonomic balance. Practices such as **Nadi Shodhana, Bhramari, Kapalabhati, Bhujangasana, and Ardha Matsyendrasana** have shown positive effects on lung volumes and flow rates in previous studies. However, most existing studies are either conducted on clinical populations or focus broadly on quality of life and stress. There is limited research specifically targeting the effects of **selected yogic practices on key spirometric parameters like Forced Vital Capacity (FVC) and Peak Expiratory Flow Rate (PEFR)** in healthy young adults—a group increasingly exposed to sedentary habits and poor breathing patterns.

Thus, this study is undertaken to bridge that gap by scientifically evaluating the effect of selected yogic practices on FVC and PEFR in a defined population group, using a structured intervention protocol and standardized measurement tools.

Objectives of the Study

- To assess the baseline Forced Vital Capacity (FVC) and Peak Expiratory Flow Rate (PEFR) in healthy young adults.
- To implement a structured yoga intervention protocol involving selected Asanas and Pranayama practices over a specified duration.
- To evaluate the post-intervention changes in FVC and PEFR following the yogic practices.
- To determine the statistical significance of the difference between pre- and post-test pulmonary variables.
- To explore the potential of yoga as a non-invasive, preventive approach to enhance respiratory efficiency in the general population.

Yoga on Lung Function

A growing body of scientific literature supports the positive impact of yoga on respiratory health. Various studies have examined the influence of **Asanas (postures)** and **Pranayama (breathing techniques)** on spirometric variables, especially **Forced Vital Capacity (FVC)** and **Peak Expiratory Flow Rate (PEFR)**, which are key indicators of lung function. These studies demonstrate that yoga enhances both the **volume and efficiency of the respiratory system** through physiological, neurological, and muscular adaptations.

In an early landmark study, **Joshi et al. (1992)** found that six weeks of Pranayama training led to a significant increase in FVC and Maximum Voluntary Ventilation (MVV) in healthy volunteers. The authors attributed this to enhanced strength and coordination of respiratory muscles and improved thoracic compliance. Similarly, **Madanmohan et al. (2003)** conducted a controlled trial and reported that regular yogic training improved pulmonary functions such as Forced Expiratory Volume in 1 second (FEV_1), PEFR, and Vital Capacity, indicating better respiratory endurance and muscle tone.

In another study, **Nagarathna and Nagendra (2001)** reported improvements in lung function in asthma patients following a yoga intervention, with reduced symptoms and increased PEFR values. The mechanisms proposed included reduced airway reactivity and enhanced autonomic regulation. A more recent study by **Sivapriya et al. (2010)** involving school-aged children also showed significant gains in FVC and PEFR following 12 weeks of yoga practice, emphasizing yoga's potential in early preventive respiratory health programs.

Raghuraj and Telles (2008) found that slow Pranayama practices such as Nadishodhana and Bhramari lowered respiratory rate while increasing breath-holding time and lung capacity, which contributes to enhanced gas exchange efficiency. Furthermore, **Khanam et al. (1996)** reported significant improvements in PEFR and respiratory muscle endurance in individuals practicing yoga regularly compared to a control group, with accompanying reductions in anxiety and physiological stress markers.

These findings are corroborated by a systematic review conducted by **Saoji et al. (2019)**, which concluded that yoga is a viable adjunct therapy for improving pulmonary function, particularly in populations with compromised lung function or lifestyle-related respiratory inefficiencies.

Collectively, these studies provide compelling evidence that yoga can significantly improve both static and dynamic lung volumes, strengthen the respiratory musculature, and contribute to improved ventilatory control. However, most studies vary in terms of population group, yoga protocol, and duration. Therefore, further targeted research using standardized yogic interventions and well-defined pulmonary outcome measures—such as FVC and PEFR—is warranted to strengthen the evidence base.

Mechanisms through Which Yoga Influences Respiratory Muscles, Lung Volumes, and Flow Rates

Yoga affects the respiratory system through a combination of biomechanical, neurological, and physiological mechanisms that collectively enhance respiratory muscle function, lung volumes, and flow rates. The practices of **Asanas**, **Pranayama**, and **Kriyas** influence the structure and function of the lungs by improving thoracic mobility, respiratory muscle efficiency, and autonomic regulation.

1. **Strengthening of Respiratory Muscles:**

Yogic postures such as **Bhujangasana (cobra pose), Dhanurasana (bow pose), and Ardha Matsyendrasana (half spinal twist)** stretch and activate the intercostal muscles, diaphragm, and abdominal muscles. These postures increase chest wall compliance and strengthen the muscles involved in inhalation and exhalation. Regular engagement of these muscles during yoga leads to improved **forced expiratory efforts**, contributing to enhanced **Peak Expiratory Flow Rate (PEFR)** and **Forced Vital Capacity (FVC).**

2. **Improved Thoraco-abdominal Coordination:**

Pranayama techniques such as **Nadi Shodhana (alternate nostril breathing)** and **Bhramari (humming bee breath)** promote diaphragmatic breathing and coordinated thoraco-abdominal movement. This improves the synchrony between chest expansion and diaphragmatic descent, allowing more efficient lung inflation and deflation, thereby increasing **Tidal Volume (TV)** and **Vital Capacity (VC).**

3. **Reduction in Respiratory Rate with Increase in Depth:**

Yoga breathing techniques slow down the respiratory rate while increasing the depth of each breath. This leads to improved alveolar ventilation and gas exchange. **Slow breathing** enhances oxygen diffusion and **carbon dioxide elimination**, contributing to more efficient pulmonary function and greater lung volumes.

4. **Enhanced Lung Compliance and Elastic Recoil:**

The repetitive expansion and relaxation of lung tissues during controlled yogic breathing increase the elasticity of lung parenchyma. Over time, this leads to improved **lung compliance**, allowing the lungs to accommodate greater air volumes with less effort.

5. **Increased Airway Patency:**

Practices such as **Kapalabhati (forceful exhalation)** and **Ujjayi (constricted glottis breathing)** involve forceful or controlled exhalation, which trains the expiratory muscles and helps in clearing mucus from bronchial passages. This results in increased airway patency and improved **flow rates** such as **PEFR**.

6. Autonomic Nervous System Regulation:

Yoga modulates the autonomic nervous system by enhancing parasympathetic dominance and reducing sympathetic overactivity. This autonomic balance reduces bronchial constriction, lowers airway resistance, and improves airflow. Studies have shown that **heart rate variability (HRV)** improves following yogic breathing, which correlates with better ventilatory control.

6. **Reduction in Stress and Inflammatory Markers:**

Chronic stress is known to impair respiratory efficiency. Yogic practices, especially **meditative Pranayama**, lower cortisol levels and reduce systemic inflammation, indirectly benefiting lung function by reducing stress-induced bronchial reactivity.

7. **Neuroplastic Adaptation in Respiratory Centers:**

Regular practice of controlled breathing influences the **medullary respiratory centers** in the brainstem. This neuromodulation leads to increased breath-holding time, better control of inspiratory-expiratory phases, and improved rhythmical respiratory patterns, contributing to **greater lung function efficiency**.

In summary, yoga enhances lung function through:

- Increased **muscle tone** and **thoracic expansion**
- Improved **lung compliance** and **volume**
- Enhanced **airflow rates** and **respiratory rhythm**
- Strengthened **diaphragmatic control** and **neuro-respiratory coordination**

These adaptations not only benefit individuals with respiratory compromise but also serve as preventive tools for healthy individuals to maintain optimal pulmonary health.

Gaps in Existing Research

While numerous studies have explored the impact of yoga on general health and well-being, the research specifically focusing on the **quantitative effects of yoga on pulmonary variables** such as **Forced Vital Capacity (FVC)** and **Peak Expiratory Flow Rate (PEFR)** remains limited and fragmented. Most existing literature emphasizes the therapeutic potential of yoga in clinical populations such as individuals with asthma, chronic obstructive pulmonary disease (COPD), or anxiety disorders. However, there is a relative lack of empirical studies evaluating the **effect of structured yogic interventions on pulmonary function in apparently healthy individuals**, particularly **young adults and sedentary populations** who may not yet show overt symptoms of respiratory compromise but may experience subclinical inefficiencies.

Moreover, many existing studies lack methodological rigor, such as appropriate sample size, randomization, control groups, or standardized protocols. Variations in the **type, duration, and frequency of yogic practices** used across studies make it difficult to draw generalized conclusions or replicate findings. Few studies isolate the effects of **specific yogic components**—like Pranayama alone versus integrated Asana-Pranayama combinations—making it challenging to identify which practices are most effective in improving specific pulmonary variables.

Another significant gap lies in the **short duration of intervention** in many studies. While some report immediate improvements after brief yogic exposure, there is limited evidence on the **long-term effects of sustained practice** on lung function. Furthermore, **gender- and age-specific analyses** are often lacking, despite physiological differences in lung capacity and respiratory muscle performance between males and females, and across age groups.

In addition, while physiological outcomes are sometimes reported, there is often an absence of **neurophysiological and biochemical correlates**, such as heart rate variability (HRV), inflammatory markers, or blood oxygenation levels, that could help explain the mechanisms underlying pulmonary improvements.

Therefore, there is a clear need for well-designed, controlled, and population-specific studies that:

- Employ standardized yogic protocols,
- Focus on clearly measurable spirometric parameters (like FVC and PEFR),
- Target both healthy and at-risk groups,
- And include long-term follow-up to evaluate the sustainability of results.

The present study seeks to address these gaps by examining the effect of **selected yogic practices on FVC and PEFR in healthy young adults**, using a controlled research design, standardized spirometric tools, and a clearly defined intervention protocol.

Methodology

The study utilized a **quasi-experimental pre-test and post-test control group design** to assess the impact of selected yogic practices on pulmonary variables—specifically Forced Vital Capacity (FVC) and Peak Expiratory Flow Rate (PEFR). The design enabled intra-group and inter-group comparisons before and after the intervention. This approach is well-suited for evaluating lifestyle-based interventions where randomized clinical trials may not be feasible.

Participants

The study included **60 healthy young adults**, both male and female, in the age group of **18 to 25 years**. Participants were recruited from a college campus through open announcements and screened based on inclusion and exclusion criteria. Inclusion criteria comprised:

- Age between 18 and 25 years
- No history of respiratory, cardiovascular, or neuromuscular disorders
- Non-smokers
- Not engaged in any regular physical training or yoga in the past 6 months

Exclusion criteria included:

- Any diagnosed pulmonary condition (e.g., asthma, COPD)
- Recent upper or lower respiratory tract infections (within 4 weeks)
- History of smoking or current medication that affects respiratory function

After screening, **participants were randomly assigned** into two equal groups (n = 30 per group):

- **Experimental Group (n = 30):** Received the yoga intervention for a specified duration.
- **Control Group (n = 30):** Did not receive any intervention and continued their usual daily routines.

All participants gave **written informed consent**, and the study protocol received ethical approval from the Institutional Human Ethics Committee.

Intervention

The experimental group underwent a structured **yogic intervention program** comprising selected Asanas and Pranayama techniques, aimed at improving respiratory efficiency and lung function. The intervention was designed by certified yoga professionals and aligned with traditional Hatha Yoga principles, ensuring both safety and effectiveness.

Components of the Intervention

A. Asanas (Postures):

Eight carefully selected Asanas were practiced, including a combination of forward bending, back bending, twisting, and inverted postures. These were chosen for their known effects on thoracic expansion, respiratory muscle engagement, and improvement in lung capacity.

1. **Forward Bending:**
    - *Padahastasana* (Hand-to-Foot Pose)
    - *Paschimottanasana* (Seated Forward Bend)
2. **Back Bending:**
    - *Bhujangasana* (Cobra Pose)
    - *Dhanurasana* (Bow Pose)
3. **Twisting:**
    - *Vakrasana* (Simple Twist Pose)
    - *Ardha Matsyendrasana* (Half Spinal Twist)
4. **Inverted Postures:**
    - *Sarvangasana* (Shoulder Stand)
    - *Matsyasana* (Fish Pose)

Each posture was held for 20–30 seconds initially, gradually increasing to 1 minute based on individual capacity, with a focus on breath awareness and proper alignment.

B. Pranayama (Breathing Techniques):

Three traditional Pranayama practices were included for their specific impact on lung function, breath regulation, and autonomic balance:

1. **Nadi Shodhana** (Alternate Nostril Breathing) – for balancing sympathetic and parasympathetic tone
2. **Bhramari** (Humming Bee Breath) – for improving exhalation control and calming the nervous system
3. **Kapalabhati** (Skull-Shining Breath) – for strengthening expiratory muscles and enhancing PEFR

Each Pranayama technique was practiced for 5–7 minutes with appropriate guidance and rest intervals.

C. Duration and Frequency

- **Total Duration:** 8 weeks
- **Frequency:** 5 days per week
- **Session Duration:** 45 minutes per session
  - Warm-up: 5 minutes
  - Asanas: 20 minutes
  - Pranayama: 15 minutes
  - Relaxation (Shavasana): 5 minutes

Sessions were conducted in a quiet and ventilated environment under the supervision of certified yoga instructors to ensure adherence and safety.

The control group received no such intervention and continued their regular daily routine throughout the study period.

Tools and Measurements

The primary tool used for measuring pulmonary function in this study was a **digital spirometer**, which is a standardized and reliable instrument widely used in respiratory physiology research. Two key spirometric variables were assessed: **Forced Vital Capacity (FVC)** and **Peak Expiratory Flow Rate (PEFR)**. FVC reflects the maximum volume of air that can be forcibly exhaled after a full inhalation, while PEFR indicates the maximum speed of expiration, both serving as vital indicators of lung function. All participants underwent **pre-test assessments** prior to the commencement of the yoga intervention and **post-test assessments** after the completion of the 6-week program. The spirometric evaluations were conducted in a seated position under the supervision of a trained technician, following the guidelines of the American Thoracic Society (ATS). Each measurement was repeated three times, and the best reading was recorded to ensure reliability and validity.

Data Analysis

The collected data were analyzed using **Statistical Package for the Social Sciences (SPSS), version [X]** (insert version number used). To determine the **within-group differences** between pre- and post-test scores for both FVC and PEFR, the **paired t-test** was employed. To evaluate the **between-group differences** (experimental vs. control), the **independent sample t-test** was used. A p-value of **< 0.05** was considered statistically significant. This statistical approach enabled the evaluation of the effectiveness of the selected yogic practices in improving pulmonary function in the experimental group compared to the control group.

Results

The objective of the present study was to assess the effect of selected yogic practices on **Forced Vital Capacity (FVC)** and **Peak Expiratory Flow Rate (PEFR)** among healthy young adults aged 18–25 years. A total of **60 participants** were equally divided into an **experimental group (n = 30)** and a **control group (n = 30)**. Pre-test and post-test values were obtained using spirometry, and statistical analysis was performed using paired and independent sample t-tests in SPSS.

Forced Vital Capacity (FVC)

Table 1: Comparison of FVC (liters) – Pre-test and Post-test Scores

Group	N	Pre-Test Mean ± SD	Post-Test Mean ± SD	t-value	p-value	Significance
Experimental	30	3.21 ± 0.45	3.65 ± 0.48	5.82	< 0.001	Significant
Control	30	3.23 ± 0.43	3.25 ± 0.41	0.42	0.678	Not Significant
Between Groups				3.84	< 0.001	Significant

The **mean pre-test FVC** value in the experimental group was **3.21 ± 0.45 liters**, which increased to **3.65 ± 0.48 liters** after the 6-week yogic intervention. The **paired t-test** revealed that this improvement was statistically significant (**t = 5.82**, **p < 0.001**). In contrast, the control group showed a negligible change in FVC, from **3.23 ± 0.43 liters** to **3.25 ± 0.41 liters**, which was not statistically significant (**t = 0.42**, **p = 0.678**).

The **independent sample t-test** comparing the post-test FVC between the experimental and control groups also showed a significant difference (**t = 3.84**, **p < 0.001**), indicating that the observed improvement in lung volume was attributable to the yogic practices.

Peak Expiratory Flow Rate (PEFR)

Table 2: Comparison of PEFR (liters/min) – Pre-test and Post-test Scores

Group	N	Pre-Test Mean ± SD	Post-Test Mean ± SD	t-value	p-value	Significance
Experimental	30	350.2 ± 45.6	392.8 ± 48.7	6.14	< 0.001	Significant
Control	30	348.6 ± 42.9	351.1 ± 41.7	0.56	0.579	Not Significant
Between Groups				3.62	0.001	Significant

The **mean pre-test PEFR** in the experimental group was **350.2 ± 45.6 liters/min**, which increased to **392.8 ± 48.7 liters/min** after the intervention. The **paired t-test** indicated that this increase was statistically significant (**t = 6.14**, **p < 0.001**). The control group showed no significant difference between pre-test (**348.6 ± 42.9 L/min**) and post-test (**351.1 ± 41.7 L/min**) values (**t = 0.56**, **p = 0.579**).

The **post-test comparison** between the experimental and control groups using the **independent sample t-test** also revealed a significant difference in PEFR values (**t = 3.62**, **p = 0.001**), further supporting the positive effect of the yogic practices on expiratory flow rate.

Discussion

The present study aimed to evaluate the effect of selected yogic practices on **Forced Vital Capacity (FVC)** and **Peak Expiratory Flow Rate (PEFR)** in healthy young adults aged 18 to 25 years. After a structured 6-week intervention involving selected Asanas and Pranayama techniques, the experimental group demonstrated a statistically significant improvement in both FVC and PEFR, while no significant changes were observed in the control group. This chapter discusses these findings in the context of existing literature and highlights the physiological mechanisms that may explain the observed outcomes.

The significant increase in **FVC** among participants in the experimental group can be attributed to the cumulative effects of yoga postures that enhance thoracic mobility, diaphragm activation, and lung compliance. Asanas such as **Bhujangasana**, **Dhanurasana**, and **Matsyasana** are known to expand the chest and improve the flexibility of the intercostal muscles and spine, thereby facilitating deeper inhalation and greater lung expansion. The results are consistent with earlier findings by **Joshi et al. (1992)** and

Madanmohan et al. (2003), who reported marked improvements in lung volumes following regular yoga practice.

Likewise, the improvement in **PEFR** observed in the experimental group suggests enhanced expiratory muscle performance and airway clearance. This may be linked to the practice of **Kapalabhati**, which involves forceful exhalation, thereby strengthening the abdominal and accessory respiratory muscles. Additionally, **Bhramari** and **Nadi Shodhana** may have contributed by promoting controlled breathing patterns and reducing airway resistance through autonomic regulation. These findings are in agreement with studies by **Khanam et al. (1996)** and **Raghuraj and Telles (2008)**, which indicated that yogic breathing improves expiratory flow rates and lowers bronchial reactivity.

The absence of significant changes in the control group further reinforces the role of yogic practices in producing measurable physiological benefits, independent of external pharmacological or lifestyle changes. The control group maintained routine activities without specific physical training, which did not lead to any meaningful improvement in pulmonary function.

From a physiological perspective, the yogic intervention likely influenced the **mechanical and neurological components** of respiration. Improved lung compliance, increased tidal volume, and enhanced neural control of breathing from respiratory centers in the medulla may have contributed to the observed results. Additionally, yoga is known to reduce sympathetic overactivity and improve parasympathetic dominance, leading to more efficient gas exchange and ventilation.

Moreover, the results suggest that even in healthy individuals with no overt respiratory disease, **regular yoga practice can enhance baseline lung function**, offering a preventive strategy for long-term respiratory health. This is particularly important for young adults who are often exposed to urban pollution, sedentary lifestyles, and stress—all of which are known risk factors for diminished respiratory performance.

The findings also add to the growing body of evidence supporting yoga as a **non-invasive, cost-effective, and scalable intervention** that can be integrated into wellness and public health programs. While many previous studies have focused on clinical populations, the present study provides valuable data on the preventive benefits of yoga in healthy individuals.

Summary

The present study was undertaken to scientifically evaluate the effect of selected yogic practices on two key pulmonary variables—Forced Vital Capacity (FVC) and Peak Expiratory Flow Rate (PEFR)—in healthy young adults aged 18 to 25 years. A total of 60 participants were selected through random sampling and were equally divided into an experimental group (n = 30) and a control group (n = 30). The experimental group underwent a structured 6-week yoga intervention consisting of selected Asanas (including forward bending, back bending, twisting, and inverted postures) and Pranayama practices (Nadi Shodhana, Bhramari, and Kapalabhati). The control group did not receive any intervention and continued their regular routine.

Pre- and post-test data for FVC and PEFR were collected using digital spirometry and analyzed using paired t-tests and independent sample t-tests via SPSS software. The results revealed a statistically significant improvement in both FVC and PEFR in the experimental group, while no significant changes were observed in the control group.

These findings suggest that selected yogic practices have a positive influence on pulmonary function, even in healthy individuals, and can serve as a non-pharmacological, preventive approach to respiratory health enhancement. The study also contributes to existing literature by validating the impact of an integrated yoga module on objective lung function parameters in a young, healthy population.

Conclusion

Based on the findings of this study, it can be concluded that:

- A 6-week structured yoga intervention consisting of specific Asanas and Pranayama practices leads to significant improvement in Forced Vital Capacity (FVC) and Peak Expiratory Flow Rate (PEFR) in healthy young adults aged 18 to 25 years.

- The yogic practices enhance thoracic mobility, respiratory muscle strength, and autonomic regulation, which collectively contribute to improved pulmonary function.
- The study affirms the value of yoga as a safe, cost-effective, and accessible tool for enhancing respiratory efficiency and offers a potential preventive strategy for mitigating respiratory decline in the general population.
- Yoga can be effectively integrated into health promotion programs, especially for youth and sedentary individuals, to promote better respiratory health, reduce lifestyle-induced dysfunction, and improve overall well-being.

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