Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol.14 , Issue 33s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Efficacy of Yoga therapy management in Respiratory disorders

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.Cite this paper as Chhaya Negi, Dr. Mohit Bhatia, Dr. Sunanda R Pedhekar (2025) Efficacy of Yoga therapy management in Respiratory disorders Journal of Neonatal Surgery, 14, (33s) 683-693

ABSTRACT

Introduction: Numerous studies have examined the impact of yoga therapy in the management of respiratory disorders, specifically Bronchial Asthma and Chronic Obstructive Pulmonary Disease (COPD). However, these studies exhibit significant variability in sample sizes and methodologies, resulting in inconclusive findings. Therefore, the present study aims to conduct a systematic review to evaluate the efficacy of yoga therapy in the management of respiratory disorders, thereby providing clearer insights into its potential benefits.

Methods: A comprehensive search was conducted across several prominent databases, including PubMed, EMBASE, the Cochrane Library, Google Scholar, and ClinicalTrials.gov, to identify relevant studies. These databases were searched using the keywords yoga and pulmonary function. All the potential studies were included based on Prisma guidelines. The primary outcomes of interest included forced expiratory volume in one second (FEV1), forced vital capacity (FVC), peak expiratory flow rate (PEFR), and the percentage of FEV1, FVC, and PEFR relative to predicted values (% pred). Additionally, we examined secondary outcomes such as the 6-minute walking distance (6 MWD). To evaluate effect sizes, we calculated weighted mean differences (WMDs) along with 95% confidence intervals (CIs).

Results: In a comprehensive analysis of five randomized controlled trials (RCTs) involving a total of 233 participants, it was found that yoga therapy notably enhanced respiratory health. Specifically, there was a remarkable improvement in Forced Expiratory Volume in 1 second (FEV1), which increased by an average of 123.57 mL (with a 95% confidence interval of 4.12 to 243, P=0.04). The percentage of FEV1 compared to predicted values also saw a significant boost, averaging an increase of 3.90% (95% CI: 2.27 to 5.54, P<0.00001). The results indicated that yoga intervention (YI) significantly improved FVC% (WMD: 3.03 L, 95 % CI: 1.71, 4.35, P < 0.00001), FEV1 (WMD: 0.47 L, 95 % CI: 0.43, 0.51, P < 0.00001), and FEV1% (WMD: 5.74 L, 95 % CI: 4.47, 7.01, P < 0.00001) when compared to control groups. However, no significant effect was observed on FVC (WMD: 0.23 L, CI: 0.16, 0.62. P = 0.25), PEFR (WMD: 0.49, CI: 0.70, 1.67, P = 0.42), MVV (WMD: 9.01, CI: 3.92, 21.94, P = 0.17), and FEV1/FVC (WMD: 3.17, CI: 1.15, 7.48, P = 0.15) as a result of YI. Furthermore, participants demonstrated a notable improvement in their 6-minute walk distance (6 MWD), with an average gain of 38.84 meters (95% CI: 15.52 to 62.16, P=0.001).

Conclusions: The existing evidence indicates that yoga therapy may significantly enhance lung function and boost exercise capacity, making it a promising complementary approach for individuals coping with respiratory conditions such as bronchial asthma and chronic obstructive pulmonary disease (COPD). While these initial findings are encouraging, further research is essential to validate our preliminary observations and to explore the enduring benefits of long-term yoga practice on respiratory health..

Keywords: Bronchial Asthma, Yoga Therapy, Pulmonary function, FEV1, FVC, PEFR, and Yogic Intervention

INTRODUCTION

Respiratory disorders are among the most common non-communicable diseases worldwide, largely due to the ubiquity of noxious environmental, occupational, and behavioural inhalational exposures **(1)**. In addition to the respiratory disorders, such as chronic obstructive pulmonary disease (COPD) and asthma, unfortunately, they have received proportionately less public attention and less research funding than other disease entities, such as cardiovascular disease, cancer, stroke, diabetes, and Alzheimer's disease **(2-3)**. Therefore, to better inform prevention, screening, treatment, and research efforts dedicated to respiratory disorders, it is crucial to understand their prevalence, morbidity, and mortality, both on global and regional scales.

In the Global Burden of Diseases (GBD) 2025, the prevalence and attributable health burden of respiratory disorders **(4)**. They found that close to 545 million people in the world had a chronic respiratory disease in 2025, an increase of 39·8% since 1990. The high-income super-region had the highest prevalence of chronic respiratory diseases, while South Asia and sub-Saharan Africa had, somewhat surprisingly, the lowest prevalence. The most prevalent chronic respiratory diseases were COPD (3·9% global prevalence) and asthma (3·6%). Chronic respiratory diseases accounted for 3·9 million deaths in 2025 (an increase of 18·0% since 1990) and were responsible for 1470 disability-adjusted life-years (DALYs) per 100 000 individuals (112·3 million total DALYs, an increase of 13·3% since 1990). South Asia had the highest mortality attributable to chronic respiratory disease, while sub-Saharan Africa had the lowest **(5-6)**. COPD and asthma were the top causes of chronic respiratory disease-related deaths worldwide.

Recent evidence-based clinical practice guidelines and statements have shown that pulmonary rehabilitation is widely accepted as the most effective non-pharmacotherapy in the management of COPD **(7,8,9)**. Research has indicated that various physical practises, such as yoga therapy **(10),** can relieve dyspnea, improve lung function, and improve the quality of life of asthma and COPD patients **(11,12,13)**. Furthermore, a physical therapist-assisted intensive flexibility training that focuses on stretching and rib cage mobilization can significantly improve 6-min walking distance (6 MWD) **(14,15)**. Yoga originated in ancient India and may denote the union between the individual self and the transcendental self. The body's organs and systems are cleansed through asanas (postures) and pranayama (controlling the breath). Along with meditation, yoga asanas and pranayama have become popular in the West, and the practice of yoga has become "westernized." Postures are taught as ends in themselves, that is, to heal an illness, reduce stress, or look better. It is a valuable gift of Indian Vedic philosophy to the modern world. It is a well-known fact that any sort of exercise done repeatedly is beneficial to the body. Yoga is a very good exercise for maintaining proper health and has a profound effect on the lung functions of an individual. **(16).** Yogic practises have been shown to have positive effects on people with asthma **(17),** cardiac diseases **(18)**, diabetes **(19),** tuberculosis **(20),** depressive disorders **(21),** and osteoarthritis **(22).** Several clinical trials have suggested that yoga therapy may improve the pulmonary function of patients with asthma and COPD **(23,24,25)**, but the quality of these studies has not been evaluated systematically. Therefore, we undertook a systematic review of available randomized controlled trials (RCTs) to assess the efficacy of yoga therapy on pulmonary function and other clinical endpoints in patients with asthma and COPD.

2. METHODOLOGY

This systematic review has been conducted according to the Preferred Reporting Items for Systematic Reviews (Prisma) guidelines **(26)** and recommendations of the Cochrane Collaboration **(27).**

2.1 Search strategy/literature searches:

A comprehensive search was conducted across several prominent databases, including PubMed, EMBASE, the Cochrane Library, Google Scholar, and ClinicalTrials.gov, to identify relevant studies. from January 2012 to December 2022. The above-indicated databases were searched using the strategy 'Keywords in title, abstract, and keyword' methodology. In the title, abstract, or keywords, search terms about yoga practice and its effect on pulmonary functions were included in the chosen search strategy. The PubMed electronic search approach was developed "(Yog* [Title/Abstract]) AND (Pulmonary [Title/Abstract]), (Yog* [Title/Abstract]) AND (Pulmonary function [Title/Abstract]), (Yog* [Title/Abstract]) AND (FVC [Title/ Abstract]), (Yog* [Title/Abstract]) AND (FEV1 [Title/Abstract]). All the potential studies were included based on Prisma guidelines. The primary outcomes of interest focused on forced expiratory volume in one second (FEV1) and the percentage of FEV1 compared to predicted values (% pred). In addition, we explored secondary outcomes such as the 6-minute walking distance (6 MWD). To assess the effect sizes, we calculated weighted mean differences (WMDs) along with 95% confidence intervals (CIs).

2.2 Selection of studies:

A two-step procedure was used to identify the studies: title/abstract screening and full-text review. To identify possibly eligible searches, two independent reviewers (V.R. and S.S.) went through the titles/abstracts of the articles that were retrieved. Based on predetermined eligibility criteria, the entire texts of these potentially relevant studies were then evaluated for eventual inclusion. A third reviewer (N.Y.) was consulted to settle any disputes between the first two reviewers.

2.3 Eligibility criteria:

A set of predetermined eligibility criteria was developed to find pertinent studies to include in the systematic review. The population, intervention, comparison, outcomes, and study design (PICOS) framework served as the basis for the formulation of these criteria. Population: The target population consisted of patients diagnosed with any chronic or acute medical condition affecting pulmonary function, asthma, or COPD. Healthy individuals or general populations were excluded. Studies that only measured subjective respiratory outcomes (quality of life & dyspnoea scores), and did not include objective PFTs, were excluded. Intervention: Yoga therapy, either as a stand-alone treatment or in combination with other therapies such as pharmacological interventions, lifestyle changes, or other complementary and alternative methods, was of interest. The study where yoga was combined with other exercise interventions (aerobic training, joint exercise, asanas & breathing practices) without isolating its effects on pulmonary functions was excluded from the intervention. Comparison: Any controlled intervention (no treatment, standard care, placebo, and other active interventions) was included to evaluate the comparative effectiveness of yoga therapy. Studies without a well-defined control group were excluded. Study Design: Inclusion criteria were restricted to RCTs published as full-text articles. Observational studies, case reports, conference abstracts, and editorials were excluded. Non-English language publications were not considered.

2.4 Data extraction:

The data extraction was performed independently using a predefined data extraction form. The extracted data included study characteristics (authors, year of publication, study design) with Jadad score, sample size, participants' characteristics (age, diagnosis), intervention details (type of yoga, frequency, and duration), comparator group details, and outcomes. Any disagreement in data extraction was settled through discussion or consultation with a third reviewer.

2.5 Quality assessment and risk-of-bias assessment:

The Jadad scale assigns a score ranging from 0 to 5 based on randomization, blinding, and description of withdrawals & dropouts used for the methodological quality of the included studies **(28).** Studies scoring ≤2 was considered to have low quality, while those scoring ≥3 were considered to have high quality **(29).** The risk of bias in the included studies was assessed using the guidelines provided in the "Cochrane Handbook for Systematic Reviews of Interventions.

2.6 Data synthesis and analysis:

Data synthesis and analysis were carried out using "Review Manager Software (RevMan) version 5.3". For the continuous outcomes, standardized mean differences (SMDs), with 95 % confidence intervals (CIs) were calculated. Based on the potential articles, the data synthesis was done by categorizing the study findings under the effect of the yogic intervention on (1) respiratory muscular strength and (2) pulmonary function parameters. The study findings and quality assessments of the included articles were tabulated. The mean and standard deviation for pulmonary function parameters were imputed, and hence studies were included to perform systematic review. Random-effects models **(30)** were used when there was significant heterogeneity; otherwise, fixed-effects models were used. The I 2 statistics were used to assess study heterogeneity, which ranged from low (0–40 %) to moderate (30–60 %), substantial (50–90 %), and considerable (75–100 %) **(31,32).** Due to the smaller number of studies included in each analysis (≤ 10), potential publication bias was not investigated. Statistical significance was defined as a p-value less than 0.05 when compared to the overall effect in the control group.

3. RESULTS

3.1. Study selection

Fig. 1 shows the PRISMA flow diagram of the entire search procedure and the methodology used to select the studies. After a preliminary database search, 291 studies were selected for screening. Five studies met the inclusion criteria for the systematic review and quality evaluation. ***Table 1.*** summarizes their main characteristics. The sample sizes ranged from 30 to 276. The included studies were published between January 2012 and December 2022, with intervention durations ranging from four weeks to one year.

3.2. Study characteristics:

The studies included in this analysis demonstrated notable variations in sample range, age distribution, health conditions, intervention durations, and outcome measures. The sample range across the studies spanned from 30 participants **(33)** to a larger cohort of 276 participants **(34),** with a total of 935 participants across the studies. The studies targeted diverse age groups, including older adults **(35),** children, with specific age ranges**.** The Intervention durations ranged from four weeks **(34,36)** to a longer-term study duration of one year **(37),** reflecting the diversity in the implementation of the intervention protocols. The outcome measures reported in the studies included FVC reported in five studies **(38,39,40,41,42),** three studies reported FVC% **(43,44),** five studies reported FEV1 **(40,42,43,44),** and three studies reported FEV1 %. PEFR was reported in three studies, and PEFR% was reported in two studies **(40,41).** MVV and FEV1/FVC were reported in three **[38,40,42]** and two studies, respectively. One study reported the 6-minute walking distance (6 MWD).

The findings that Yoga Therapy (YT) has a significant positive effect on key lung function parameters, particularly Forced Vital Capacity (FVC %) and Forced Expiratory Volume in one second (FEV1 and FEV1 %). The pooled results revealed statistically significant improvements in FVC % and FEV1 with large effect sizes and no observed heterogeneity. FVC %

was observed (Z = 4.49, WMD = 3.03 L, 95% CI: 1.71–4.35; $p < 0.00001$) with no heterogeneity (p = 0.63. FEV1 % demonstrated a significant pooled increase (Z = 8.84, WMD = 5.74, 95% CI: 4.47–7.01; $p < 0.00001$) with non-significant heterogeneity (p = 0.50). **(34,43,44).**

Forced expiratory volume in 1st second (FEV1) outcomes were reported in five studies **(31,34 37,43).** The combined results showed a significant increase in FEV1 (Z = 26.02) with a WMD of 0.47 L, 95 % CI [0.43, 0.51], at a p-value of less than 0.00001. There was no significant heterogeneity at p = 0.63, I 2 = 0 %. Similarly, three studies reported changes in FEV1 % **(41,42,43)** and the pooled findings demonstrated a significant increase in FEV1 % (Z = 8.64) with a WMD of 5.74 L, 95 % CI at a p-value of less than 0.00001. The heterogeneity observed was not significant at p = 0.50, I 2 = 0 %.

In contrast, parameters reflecting airflow and ventilatory capacity, such as Peak Expiratory Flow Rate (PEFR and PEFR %) and Maximum Voluntary Ventilation (MVV), did not demonstrate statistically significant improvements following YT. Regarding PEFR, three articles reported outcomes **(33,34,35,37).** The cumulative analysis showed that YI did not have a significant effect on PEFR (Z = 0.80) with a WMD of 0.49 L, 95 % CI [− 0.70, 1.67], at a p-value of 0.42. Considerable heterogeneity was observed at $p < 0.00001$, I 2 = 98 %. Two articles reported changes in PEFR % **(36,41),** and the analysis indicated no significant improvement in PEFR % (Z = 0.03) with a WMD of 0.08 L, 95 % CI [− 5.66, 5.82], at a p-value of 0.98. Substantial heterogeneity was observed at p = 0.04, I 2 = 77 %. Three studies reported outcomes for MVV. The overall findings suggested a non-significant difference in MVV (Z = 1.37) with a WMD of 9.01, 95 % CI [− 3.92, 21.94], at a p-value of 0.17. Considerable heterogeneity was observed at $p < 0.00001$, I 2 = 96 %.

These outcomes were characterized by substantial to considerable heterogeneity ($p < 0.0000$), suggesting marked variability in intervention protocols, participant characteristics, or measurement methods across studies **(36,38,40,43).** Additionally, FEV1/FVC ratio did not show a significant pooled effect and was also associated with considerable heterogeneity, indicating that YT may have a limited or inconsistent influence on airway obstruction indices **(40,41).**

Overall, these findings suggest that Yoga Intervention (YT) has a more consistent and beneficial effect on lung volume–related parameters, whereas its impact on airflow-dependent and ventilatory measures remains variable and inconclusive. This underscores the need for well-designed, standardized, randomized controlled trials to further clarify the role of YT in improving comprehensive pulmonary function outcomes in respiratory disorders such as asthma and COPD. These findings clearly demonstrate that YI has a significant and variable impact on pulmonary and respiratory functions within the clinical population.

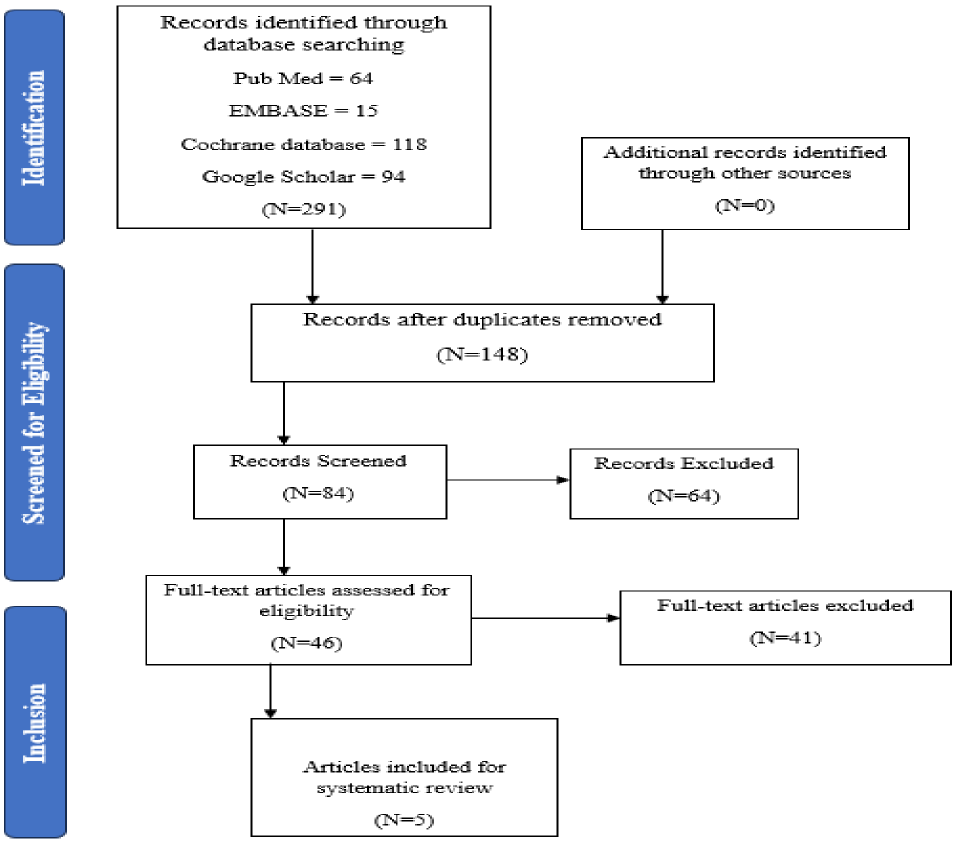

Fig. 1 shows the PRISMA chart for the extraction of data.

Table 1: Characteristics of studies included in the systematic review

Program length, frequency, and duration						
Author, year	**Study design**	**N**	**Age**	**Treatment**	**Control**	**Outcomes**
Iranzo et al., 2014 **(34)**	Open-label randomized controlled trial/ 5	81	Older than 65 years	(1) ITT group performed inspiratory muscle training (2) YRT group performed yoga breathing exercises 5 days/week for 6 weeks	Not performed any training	YRT group had a greater increase of RM strength (MIP and MEP) and endurance (MVV) than control and/or ITT groups.
Yadav et al., 2015 **(35)**	Prospective randomized parallel group controlled study/5.5	80	45–65 years	Yoga regimen (yogic postures, pranayama breathing, exercises, dietary modification, and holistic teaching) daily for 60 min (6 days/week) for 3 months	Conventional medicine	Significant improvement in SLCFVC, PEFR, MVV, DLCO, HR, SBP and DBP in Group-I.
Agnihotri et al., 2016 **(36)**	RCT/5	276	12–60 years.	Yogic intervention (asanas, pranayama, and meditation) for 30 min per day, 5 days in a week for a period of 6 months	Standard medical treatment	FVC, FEV1, FEV1/FVC, and PEFR. Significantly better improvement in all PFT(Pulmonary Function Test) variables in the yoga group.
				Pranayamas (kapalabhati, bhastrika, ujjayi and sukhapurvaka pranayama), meditation, and shavasana, 45 min twice daily, regularly for remaining 6 weeks		
Pushpa and Sharma., 2018 **(37)**	RCT/2	60	18–50 years	Yoga practice for 1 h, 2 times a week for 12 weeks	Pharmacological Treatment	Yoga group showed progressive improvement in FEV1, FVC, FEV1/FVC, PEFR, FEF25-75, and sGAW;

Yudhawati and RasjidHs., 2019 **(38)**	RCT (pre and post-test control group design)/2	30	Above 40 years	Pranayama (Kapalbhati, ujjayi and anuloma viloma), 20 min once daily for a month.	Lung rehabilitation brochure	significant reduction in RAW after 4th and 8th weeks of yoga training.
Yuce and Tascı, 2020 **(39)**	Single-blind, randomized, controlled trial	55	Above 18 years	Yoga session in morning and Physiotherapy session in evening each 45 min for an year	standard medical treatment	Significant increase in FEV1, 6-MWD and quality of life in YG as well as treatment group as compared to control group.
Dhargav et al., 2021 **(40)**	RCT	124	15-40 years	Yogic intervention (asanas, pranayama, and meditation) for 45 min per day, 6 days in a week for a period of 12 weeks	Home based physiotherapy exercises for 45 min, two sessions a day for an year	Significant increase in ACT score and overall AQLQ score in pranayama group; no significant difference between the groups in terms of PFT parameters.
Yadav et al., 2021 **(41)**	Prospective open-label randomized controlled study	140	Above 18 years	Yoga therapy for max. 1 h daily for 4 week	Pharmacological treatment	Significant increase in FVC, PEFR, MVV and MVt in group I; significant increase in FVC, MVt from baseline up to one year and MVV increase from baseline up to nine months in group II.
Gunjiganvi et al., 2021 **(42)**					Conventional chest physiotherapy	Significant improvement in FVC, FEV1, FEV1/ FVC, PEFR and meanPAQLQ score in yoga

	Prospective open-label randomized controlled study	89	18–65 years			group as compared to control. Significant increase in FVC, FEV in the yoga therapy group; significant improvement in physical component of QoL, respiratory muscle endurance.

4. Discussion

This systematic review represents a pioneering effort to thoroughly evaluate previous studies on respiratory disorders, such as asthma and COPD, and the beneficial health effects of yoga therapy. The duration and Technique of the yoga practice protocol affected the outcomes of YI. The yoga protocols used in these studies are presented in ***Table 1***. A minimum of four weeks of yoga therapy lasting 60 min has been found to improve pulmonary function significantly. Yoga training time experiments have shown that a 12-week regimen performed at least twice a week for an hour is likely to result in noticeable improvements in pulmonary function. Several factors likely contribute to these findings. Primarily, the isometric contraction of muscles during yoga poses is known to increase skeletal muscle strength **(48).** Yoga poses involving lumbar and thoracic extension assist in expanding the chest wall, as demonstrated in various studies highlighting the positive effect of increased spinal mobility on pulmonary function in patients with spinal cord injuries **(49,50).**

Different asanas and pranayama techniques have been shown to enhance the strength and endurance of the diaphragm, upper abdominal, and thoracic cavities during inspiration and extend the diaphragm's range of motion. Yoga breathing (pranayama) improves vital capacity (VC) and facilitates efficient diaphragmatic movement **(51).** Pranayama also enables deeper breathing and prolonged breath-holding with reduced effort, thus increasing respiratory capacity **(52).** Slow yoga breathing (pranayama) has been shown to reduce chemo-reflex responses to hypoxia and hypercapnia in healthy practitioners, resulting in higher FVC and PEFR after 12 weeks of regular practice **(53).** Improvement in FEV1 and FVC may be associated with reduced airway resistance and improved lung compliance, potentially attributable to the non-specific broncho-protective or broncho-relaxing effects of yoga practice **(54).** Studies have also demonstrated that slow yoga breathing, when practiced correctly, improved blood oxygenation without increasing ventilation, reduced sympathetic activity during altitude-induced hypoxia, and decreased chemo-reflex sensitivity to maintain mobility in the thoracic cage, which is essential for preventing a decline in chest compliance over time. The vertical nature of yoga breathing provides additional benefits. Vertical breathing ensures a uniform opening of alveoli in both lungs. When all alveoli expand uniformly, a significant portion of the alveolar membrane becomes available for gas exchange. Optimal gas exchange occurs when a vast surface area is accessible **(55).** Normally, only a small portion of lung capacity is utilized, leading to inadequate oxygen supply and compromised waste disposal processes. Controlled breathing activities, such as pranayama, deepen respiration, expand the lungs beyond their usual limits, and re-engage previously collapsed alveoli. Lung muscle endurance improves with regular yoga practice **(56).** Yoga-based intervention, including yoga asanas and pranayama, has been found to have a positive impact on pulmonary function. The improvements observed in FVC%, FEV1, and FEV1 % can be attributed to enhanced respiratory muscle strength, improved lung compliance, reduced airway resistance, and broncho-protective effects. The practice of yoga also contributes to increased respiratory capacity, thoracic mobility, and alveolar ventilation. Further research is needed to gain deeper insights into the underlying mechanisms and optimize the therapeutic application of yoga for respiratory health.

According to a study, regular yoga practice for 10 weeks can improve pulmonary function **(38),** and another study confirmed that at least 8 weeks of yoga training can improve pulmonary function **(6).** Researchers claimed in their study that a minimum of 4 weeks of yoga training is optimum to enhance pulmonary functions **(31, 36).** Another study had taken a one-year time duration for Yoga Intervention (YI) and found a significant increase in pulmonary function **(35).** A study employed a month of YI and found no significant improvement in PFT parameters **(34).** Two studies implemented 6 weeks of yoga intervention and enhanced respiratory muscle strength and pulmonary function **(28,33).** A randomized controlled trial after performing 12 weeks of YI reported an improvement in pulmonary and cardiovascular parameters **(29)** such as slow vital capacity (SVC), FVC, FEV1, PEFR, MVV, DLCO, Heart Rate (HR), Systolic Blood Pressure (SBR), Diastolic Blood Pressure (DBP), and Mean Blood Pressure (MBR). This indicates that the yoga protocol duration had varied impacts on various clinical populations. As this systematic review revealed YI is likely to improve pulmonary function and should last at least 4 weeks daily, every day for a minimum of 60 minutes. To observe a noticeable improvement in pulmonary function parameters, yoga training for at least 45 minutes twice a day must be practiced for 6 weeks. The current study revealed that yoga protocol durations ranged from 4 weeks to a year. It is likely that longer and more frequent training sessions each week and regular yoga practice result in greater therapeutic benefits. The ideal practice timeframe for a YI's long-term effects needs to be investigated extensively. While pharmacological treatments such as bronchodilators, corticosteroids, and pulmonary rehabilitation programs remain essential for managing chronic respiratory diseases like asthma and COPD, yoga-based interventions provide additional benefits. Studies suggest that yoga, particularly pranayama, can enhance respiratory muscle endurance, improve airway resistance, and promote autonomic regulation effects that are not directly targeted by traditional medicines **(45,46).** Yoga has been linked to higher oxygenation saturation, lower inflammation, and increased vagal tone, which contributes to long-term respiratory benefits **(56).** Pranayama, as opposed to traditional pulmonary rehabilitation, may offer a non-pharmacological approach to improving lung function and exercise tolerance **(47,48).** More rigorous comparative studies are required to directly compare yoga intervention and its effectiveness to standard medical treatments.

5. Conclusion

This study concludes that yoga interventions significantly improve pulmonary function, particularly lung volume–related parameters, in clinical populations and may be used as an effective adjunct therapy for respiratory disorders. The benefits are mainly attributed to pranayama and asanas, which enhance breathing efficiency and respiratory mechanics. However, heterogeneity across studies due to variations in design and intervention protocols limits generalizability. Therefore, well-designed, large-scale randomized controlled trials with standardized yoga protocols are required to confirm long-term efficacy and support clinical integration.

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