

ORIGINAL RESEARCH

Effect of Yoga on Patients with Chronic Obstructive Pulmonary Disease as Evaluated by Six Minute Walk Test and Spirometry

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ABSTRACT

Background: COPD is a chronic progressive respiratory disease which is a major public health concern. Yoga therapy can have a salutary effect on general and respiratory health improving a person's ability to perform activities of daily living. **Methods:** A prospective study was conducted with 176 COPD patients following research ethics guidelines. Base line anthropometric, spirometry parameters, SpO₂ and six minute walking distance was measured. Then the participants were trained with certain yoga (pranayama and breathing exercises) by trained and advised to continue those regularly at their home for one hour each day for 6 months. Participants were asked to revisit after 6 months. Where the same procedures were repeated. The data obtained in pre-yoga and post-yoga was compared by paired t test. **Result:** After 6 months of yoga, we did not find any significant improvement in lung function parameters, FEV₁, FEV₁% predicted FVC, FVC % predicted, FEV₁/FVC and PEFR. However, the study showed significant improvements in mean 6 minute walk distance (258.47 m ± 33.88 m versus 262.76 m ± 37.09 m; p < 0.01) and SpO₂% (92.43 ± 1.31 versus 92.59 ± 1.19; p < 0.01). **Conclusion:** Yoga therapy for a period of 6 months could be used as a component of comprehensive management of COPD.

Keywords: COPD, Yoga, spirometry, 6 minute walk test

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INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a chronic, poorly reversible, and progressive disease of the airways and / or alveoli characterized by dyspnea, cough and expectoration.¹ It is a growing public healthcare problem globally that is expected to worsen as the population ages and the risk factors increases.² The Burden of Obstructive Lung Diseases (BOLD) program in 2019 estimated that the global prevalence of COPD is 10.3% which translates to 391.9 million people.³ COPD is the second leading cause of disease burden in India contributing 8.7% of the total deaths and 4.8% of the total disability-adjusted life years (DALYs). The age-standardized prevalence in India was 1.5 times the global average in 2016, and the age-standardized DALYs per person were 1.7 times the global average.⁴

Currently, there are no drugs that could hinder the progress of COPD. Hence, non-pharmacological therapy, like exercise training and mind-body interventions (e.g., mindfulness-based therapy, yoga, and relaxation), as part of pulmonary rehabilitation can improve physical outcomes such as lung function, dyspnoea, exercise capacity, fatigue and psychological problems in people with COPD.⁵ Yoga, a 3000 years old Indian tradition, leads to the union of individual consciousness with that of the Universal Consciousness, causing a perfect harmony between the body, mind, and spirit. The components of yoga are exercise (*asanas*), controlled breathing (*pranayam*), nourishing diet (*satvik*), positive thinking, and meditation.⁶ Yoga has been included as a component of exercise and breathing techniques prescribed for many pulmonary rehabilitation programs. Yoga training aids

in toning up general body systems, increasing respiratory control, relaxing chest muscles, strengthen both inspiratory and expiratory muscles expanding the lungs.⁷ Additionally, yoga training improves blood circulation and facilitate diffusion and gas transport at the alveolo-capillary membrane. Finally, yoga can also alleviate mental pressure, anxiety and depression.⁸

Several trials have supported its modulating effects on the pulmonary function, both in healthy individuals, and those with respiratory diseases.^{9, 10} Studies with short term yoga therapy in COPD patients have reported improved lung function parameters, decreased dyspnoea and improved health-related quality of life.⁹

The six-minute walk test (6-MWT) is a simple cardiopulmonary testing tool for the evaluation of functional exercise capacity in normal and diseased individual. Along with spirometry, the six minute walk distance (6MWD) is useful in assessing and monitoring COPD providing functional and prognostic data that is valuable in the care of patients with COPD.¹¹

So, a new initiative has been taken to determine the effect of yoga as adjunct to conventional pharmacotherapy on lung function parameters as evaluated by spirometry and six minute walk test on COPD patients attending the out-patient department of a tertiary care hospital in Eastern India.

METHODOLOGY

Study design and Setting: This was a prospective study conducted at a tertiary care hospital, in collaboration with the departments of Physiology, Yoga, and Pulmonary Medicine.

Defining study population: The diagnosis of COPD was done as per Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria, where the presence of a non-fully reversible airflow obstruction with post-bronchodilator FEV1/FVC < 0.7 was a mandatory criteria to establish the diagnosis of COPD.¹

Selection of Participants: The subjects were recruited from previously diagnosed COPD patients who were under treatment at the out-patient department.

Sample size: Calculated sample size was 142 considering 10.3 % prevalence of COPD globally,³ taking 5% absolute precision and statistic for a level of confidence (Z) =1.96 at level of confidence of 95%. To compensate for attrition or lost to follow-up, we approached and included 200 COPD patients, and finally 176 participants were available till completion of the study. Non-random convenient sampling was done to select the study subjects.

Inclusion criteria

1. Patients with COPD belonging to age groups of 40 to 70 years and getting standard treatment.
2. Nonsmoker or has quit smoking for at least 6 months before selection.

Exclusion criteria

1. Patients with severe cardiovascular diseases
2. Tuberculosis and other infectious diseases
3. Patients who are seriously ill

Parameters studied

1. Demographic profile
2. Anthropometric data-Weight, Height, Body Mass Index(BMI)
3. Pulmonary function test parameters -FEV1, FEV1, FVC, % predicted FVC, FEV1/FVC ratio, and PEFr
4. Peripheral oxygen saturation (SpO₂)
5. Six minute walking distance (6MWD)

Intervention: Patients, after selection, were trained to perform yoga (pranayama and asana) by yoga trainer following standard protocol.¹² They were asked to practice the procedures at home for at least one hour duration daily in addition to their usual physical activity and medications for a period of 6 months.

Yoga included pranayama (30 min), asana (30 min) and life style changes (diet rich in fruits and vegetables, avoiding alcohol and smoking, proper balance between work and sleep). Subjects needed to keep records of their yoga on a daily basis.⁸

The following yoga were done as per standard protocol:^{8,12}

Pranayama (breathing exercises)

1. Bhastrika: 5 min
2. Anulom vilom: 10 min
3. Kapalbhata: 10 min
4. Bhramari: 5 times

Asana (postures)

1. Surya Namaskar: 5 min
2. Tadasana: 5 min
3. Sukhasana: 5 min
4. Paschimotanasana: 5 min
5. Shavasana: 10 min

Procedure of data collection

- a) Participants were recruited by visiting outpatient department of chest medicine during OPD hours.
- b) After detailed history and thorough physical examination, participants were further screened based on the inclusion and exclusion criteria.
- c) Base line anthropometric measurements (weight, height, BMI) were done according to techniques recommended by WHO.¹³
- d) Base line lung function test was done by Helios 401 spirometer following standard procedure.¹⁴

- e) Base line SPO₂ was measured by fingertip pulse oximeter following standard protocol.¹¹
- f) Base line six minute walk test was done and six minute walking distance was measured as per American Thoracic Society guidelines.¹¹
- g) Then the participants were trained with certain yoga (pranayama and asana) and advised to continue those regularly at their home for one hour each day for 6 months. Participants were asked to revisit after 6 months.
- h) After 6 months, the same parameters were evaluated.
- i) All reports and relevant information were communicated to the participants.

Ethical considerations

Participation in the study was voluntary and confidential. Confidentiality was secured in the processes of data collection, management and analysis.

Institutional Ethics Committee (IEC) clearance was taken prior to the study. All necessary ethics protocols were maintained during the conduction of the study. Informed and written consent were obtained from the participants after explaining the objectives and procedures of the study before they are enrolled in the study.

Data management and statistical analyses

The data quality and measurement validity was ensured. After cleaning of the data, final analysis was done using Statistical Program for Social Sciences (SPSS) version 17. Data were expressed as mean \pm standard deviation (SD) for continuous variables. All the subjects were evaluated two times, first at the time of recruitment, then after six months. The recorded parameters were compared using paired t test. All differences were considered statistically significant at $P < 0.05$ and highly significant at $P < 0.001$ (both two-tailed).

RESULT AND ANALYSIS

In present study 176 subjects were recruited. Among them 156 subjects (88.6 %) were male and 20 subjects (11.4 %) were females.

All the recruited subjects were in between the age group of 50 years to 70 years with mean age of 60.51 ± 5.262 years.

The mean anthropometric, lung function parameters, 6MWD, and SpO₂ values in COPD patients before and after 6 months of yoga are compared by paired t test as tabulated in Table 1.

Comparison of the 6 minute walking distance and SpO₂ in COPD patients before and after 6 months of yoga are graphically depicted in figures 1 and 2 respectively.

Table 1. Comparison of the pre and post yogamean anthropometric, lung function parameters, 6MWD, and SpO₂ values in COPD patients.

Parameters	Mean \pm SD		t value	p value
	Pre Yoga	Post Yoga		
Weight (kg)	53.64 \pm 5.15	53.57 \pm 5.04	1.145	0.254
BMI (kg/m ²)	21.79 \pm 3.45	21.73 \pm 3.45	1.568	0.119
FEV1	1.06 \pm 0.33	1.06 \pm 0.32	0.098	0.922
FEV1 % Predicted	46.94 \pm 15.88	47.01 \pm 15.48	-0.242	0.809
FVC	1.87 \pm 0.53	1.87 \pm 0.53	0.354	0.724
FVC % Predicted	65.94 \pm 20.66	65.93 \pm 20.66	0.338	0.736
FEV1/FVC	56.76 \pm 5.99	56.78 \pm 4.41	-0.064	0.949
PEFR (L/sec)	2.95 \pm 0.88	2.96 \pm 0.88	-0.805	0.422
6MWD (meter)	258.47 \pm 33.88	262.76 \pm 37.09	-3.162	0.002**
SpO ₂ (%)	92.43 \pm 1.31	92.59 \pm 1.19	-2.827	0.005**

BMI- Body mass index

FEV1- Forced expiratory volume in 1st second

FVC – Forced vital capacity

6MWD – Six minute walking distance

SpO₂– Capillary oxygen saturation in percentage

PEFR – Peak expiratory flow rate

**p-value<0.01 - highly significant

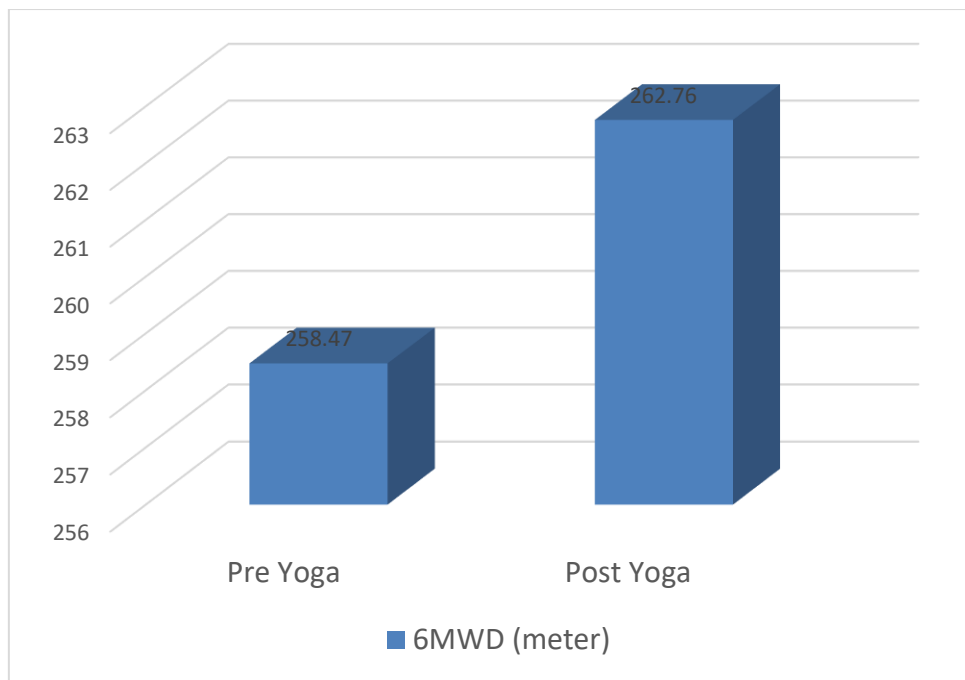


Figure 1: Comparison of the 6 minute walking distance in COPD patients before and after 6 months of yoga.

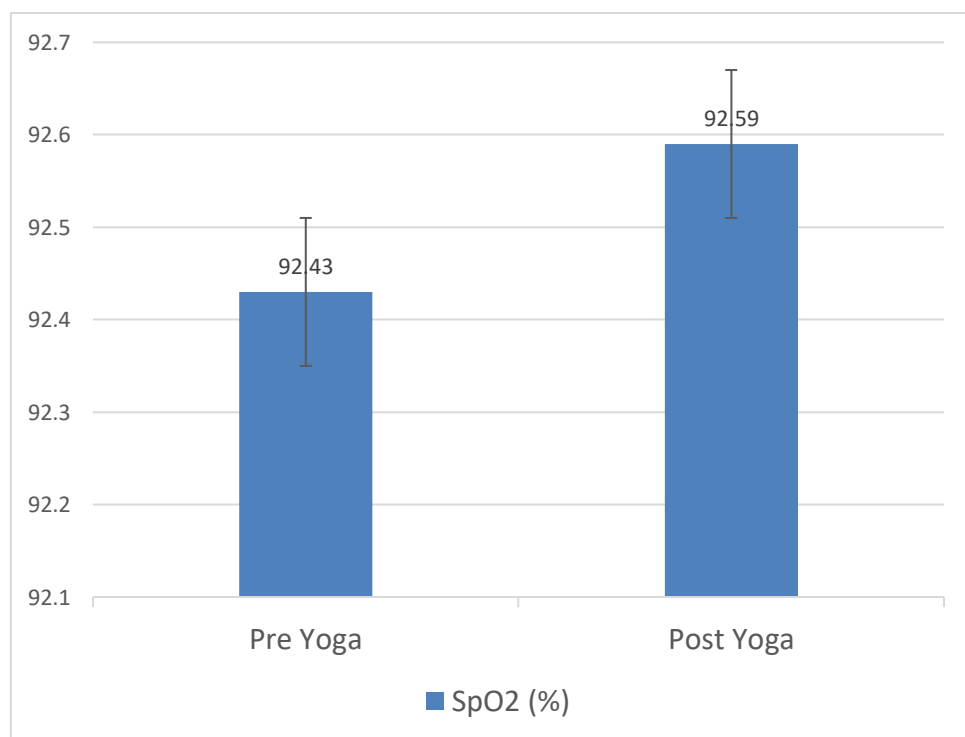


Figure 2: Comparison of the Capillary oxygen saturation (SpO₂) in COPD patients before and after 6 months of yoga.

DISCUSSION

Our study evaluated effects of 6 months yoga therapy, as an adjunct to conventional medical treatment, on lung function parameters, six minute walking distance, and SpO₂ in COPD patients. No adverse effects were observed.

In our study, though the mean BMI has decreased after yoga, but it was statistically insignificant. The

FEV₁ did not significantly change before and after performing yoga. Though mean FEV₁% predicted value has slightly increased but that was not statistically significant. Neither FEV₁/FVC ratio nor PEFR showed any significant improvement post yoga. In studies done by Katiyar S K et al.,⁶ Gupta A et al.,⁷ and Cuenco D et al.,⁹ neither FEV₁ nor FEV₁/FVC ratio showed significant improvements

after yoga therapy, indicating little effect on airflow limitation, which were similar with our study.

The reason behind not much change in FEV1, FEV1% predicted, FEV1/FVC ratio, or PEFr, might be due to air flow limitation which is not only irreversible but also usually progressive.⁷

Our study showed highly significant improvement in six minute walking distance after practicing yoga (258.47 m \pm 33.88 m versus 262.76 m \pm 37.09 m). Similar outcomes resulted in various studies performed by Gupta A et al.,⁷ Donesky et al.,⁹ and Ranjita R et al.¹⁰ This proves that yoga has a positive effect on functional exercise capacity in COPD patients.

Muscle conditioning during yoga's stretching postures improve strength, flexibility, endurance, and coordination of skeletal muscles, thereby increasing walking pace and stride length.⁶ Yoga improves cardiopulmonary endurance through body-and-breath control, leading to increased lung capacity, improved oxygen delivery and decreased pulse rate, resulting in improved exercise capacity.⁹

In our present study, there was very significant improvement in mean SpO₂ % in COPD patients after 6 months of yoga (92.43 \pm 1.31 versus 92.59 \pm 1.19) which was also noted by Ranjita R et al.¹⁰

Improvements in capillary blood SpO₂ % may be beneficial effect of pranayama, which engage normally unventilated lungs and improves perfusion. Improved breathing patterns may dilate bronchioles so that more number of alveoli can be efficiently ventilated.⁸ Pranayama increases respiratory muscle strength, reduces sympathetic reactivity, improving oxygen delivery to tissues and decreasing dyspnea.¹⁰

CONCLUSION

Results showed statistically significant improvements in six minute walking distance and capillary oxygen saturation (SpO₂) after performing 6 months of regular yoga therapy, with no significant change in lung function parameters. The study's promising results indicate the value of using yoga as a component of pulmonary rehabilitation in COPD patients along with conventional medical management.

More rigorously designed, larger scale research with longer follow-up and supervised yoga practice would have expanded the evidence base. Having additional subgroups stratified according to severity and use of control groups would have made the study more effective.

Abbreviations used

1. 6 MWT - 6 minute walk test.
2. 6MWD - 6 minute walk distance.
3. BP - Blood pressure.
4. BMI - Body Mass Index.
5. BOLD - Burden of Obstructive Lung Diseases
6. COPD - Chronic Obstructive Pulmonary Disease.

7. DALY - disability-adjusted life year
8. FEV1 - Forced expiratory volume in 1st second
9. FVC - Forced vital capacity
10. PEFr - Peak expiratory flow rate
11. SD - Standard deviation
12. SpO₂ - Capillary oxygen saturation in percentage.

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