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RESEARCH ARTICLE

Yoga as a complementary therapy improves pulmonary functions in patients of bronchial asthma: A randomized controlled trial

Pushpa K[1], Divya Sharma[2]

[1]Department of Physiology, Shridevi Institute of Medical Sciences and Research Hospital, Tumakuru, Karnataka, India, [2]Department of Pharmacovigilance, Medical Safety Advisor, IQVIA, Bengaluru, Karnataka, India

Correspondence to: Divya, E-mail: divyabhatap@gmail.com

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ABSTRACT

Background: Asthma is one of the major non-communicable diseases affecting mainly urban population worldwide. With increasing traffic, there is upsurge in air pollution levels in Bengaluru, resulting in increase in number of bronchial asthma cases. The purpose of the study was to know the effectiveness of yoga on lung functions so as to reduce the disease burden in bronchial asthma patients. **Aims and Objectives:** The aim of the study was to record pulmonary function test (PFT) in (1) Group A - 30 bronchial asthma patients practicing yoga along with pharmacological treatment and (2) Group B - 30 bronchial asthma patients who are only on pharmacological treatment and to compare the results between the two groups at baseline, after 4 weeks, and after 8 weeks. **Materials and Methods:** Study included 60 mild-moderate bronchial asthma patients, divided into Group A and Group B. PFT was done, forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), FEV_1/FVC, peak expiratory flow rate (PEFR), and forced expiratory flow rate 25–75% (FEF_{25-75}) were measured using MEC PFT and airway resistance (RAW) and specific airway conductance (sGAW) were measured using body plethysmograph at baseline, after 4 weeks and after 8 weeks in both the groups. **Results:** Group A showed progressive improvement in FEV_1, FVC, FEV_1/FVC, PEFR, FEF_{25-75}, and sGAW ($P < 0.001$) and a significant reduction in RAW after 4th and 8th weeks of yoga training. Group B showed no significant change in FEV_1, FVC, FEV_1/FVC, PEFR, FEF_{25-75}, RAW, and sGAW after 4 weeks and 8 weeks. **Conclusion:** Yoga can be used as adjunctive therapy as it significantly improves lung functions in mild-to-moderate bronchial asthma. Regular practice of yoga leads to improved quality of life in bronchial asthmatics.

KEY WORDS: Airway Resistance; Asthma; Pranayama; Pulmonary Functions; Yoga

INTRODUCTION

Bronchial asthma is one of the most common chronic diseases globally, and currently, it affects approximately 300 million people worldwide. In developing countries where the prevalence of asthma had been much lower, there is a rising prevalence which is associated with increased urbanization. The increasing global prevalence of asthma, the large burden it now imposes on patients, and the high health-care costs have led to extensive research into its mechanisms and treatment.[1] There is a rising incidence of asthma in India. Overall, the prevalence of asthma in major cities of India is 2.38%, prevalence in Bengaluru city alone is 3.47%.[2] Bengaluru is a rapidly growing city in terms of migration, transportation as well as an industrial sector from past two decades. Hence, air pollution level is increasing in Bengaluru resulting in poor air quality due to the elevated content of particulate matter which is one of the major risk factors for

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the development of asthma. This leads to increased incidence of bronchial asthma cases and acute exacerbations in chronic asthma patients. In developing countries like India, long-term use of multiple drugs is expensive. Moreover, most of the asthma-related deaths occur in low and lower-middle income countries. According to the latest WHO estimates, released in December 2016, there were 383,000 deaths due to asthma in 2015.[3] As there is a rising rate of bronchial asthma and its complications among urban population in Bengaluru city, measures have to be taken for appropriate management of asthma which can reduce the disease burden, health-care cost and also improve the quality of life of bronchial asthmatics.

Bronchial asthma is a condition characterized by chronic airway inflammation and airway hyperresponsiveness leading to symptoms of wheeze, cough, chest tightness, and dyspnea. Bronchial asthma besides being a chronic inflammatory disease of the airways also has psychosomatic imbalance and an increased vagal tone as its etiopathogenesis. Yoga therapy readjusts the autonomic imbalance, controls the rate of breathing and thus alters various physiological variables.[4] Yoga includes gentle stretching of muscles and breathing exercises with wide range of classical asanas and pranayama practices. Pranayama involves regulated breathing exercises which require a person to hold his breath, maintaining isometric contraction of respiratory muscles and also requires forceful respiration. Pranayama helps to strengthen the respiratory muscles and increases respiratory endurance.[5]

Effects of yoga on pulmonary functions in bronchial asthmatics have varied across studies. Some studies suggest that yoga when adjunctively used with pharmacological treatment in mild-to-moderate asthmatic patients lead to improvement in pulmonary functions and reduces the usage of bronchodilators.[4,6-8] Others mention that usefulness of yoga techniques in asthmatics is limited and should be further investigated.[9-11] Moreover, physicians and pulmonologists give less attention for yoga in the treatment of bronchial asthma. There is a paucity of studies showing the effect of yoga on airway resistance (RAW) and specific airway conductance in asthma patients. Hence, the purpose of the study was to assess the effect of yoga training whether it improves pulmonary functions in bronchial asthma patients as compared to those asthmatics who were only on standard pharmacological treatment. The results of this study would emphasize the importance of yoga techniques in improving pulmonary functions in asthmatics so that yoga can be included as an adjuvant therapy along with the standard pharmacological treatment and asthmatics can lead a good quality of life.

MATERIALS AND METHODS

The study was carried out in lifestyle laboratory, Department of Physiology, BMCRI, Bengaluru. Ethical clearance was taken from Institutional Ethical Clearance Committee of Bengaluru Medical College and Research Institute. The study was a randomized controlled trial conducted in Bengaluru including 60 patients with mild-moderate bronchial asthma. Subjects were selected from the diagnosed cases of bronchial asthma attending Victoria Hospital Outpatient Department for treatment, based on inclusion and exclusion criteria. The study included diagnosed cases of bronchial asthma, aged 18–50 years with an established diagnosis for at least 6 months, mild-moderate cases meeting[12] National Asthma Education and Prevention Program classification. Subjects on Inhaled B-agonist (short-acting and long-acting) with stable medication dose for past 1 month. Study excluded smokers, patients with concomitant lung disease, those who practiced yoga or any other similar discipline during 6 months preceding the study, pregnancy, any chronic medical condition that required a treatment with oral/systemic steroids in the past months, any medical condition that contraindicated exercise, history of tuberculosis, diabetes mellitus, renal failure, coronary artery disease, musculoskeletal deformities, and status asthmaticus. The written informed consent was obtained from all the subjects, and a general physical examination was done. The procedure was explained, and the subjects were randomly divided into yoga training group (n = 30) and control group (n = 30).

Yoga training group practiced yoga exercises along with the medication, Yogic exercises used by the patients included pranayamas (deep breathing exercises), kapalabhati (cleaning breath), bhastrika (rapid and deep respiratory movements like that of the bellows), ujjayi (loud sound producing pranayama) and sukhapurvaka pranayama (easy comfortable breathing), meditation, and shavasana (relaxation technique) under the guidance of trained yoga teacher for 45 min a day for the duration of 2 weeks and instructed to practice at home for 45 min twice daily, regularly for remaining 6 weeks and were instructed to maintain a dairy record of each day of yoga practice. Control group was taking only pharmacological therapy. All patients were remained on their prescribed treatment during the study. Pulmonary function test (PFT) was done in the morning hours between 9 and 10 am after a light breakfast and 30 min of rest. PFTs were recorded in both the groups at baseline, after 4 weeks and 8 weeks using M.E.C PFT body plethysmograph station. The results were tabulated in the master chart and statistically analyzed. The statistical software, namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1 and Systat 12.0, and R environment ver.2.11.1 was used for the analysis of the data and Microsoft Word and Excel have been used to generate graphs, tables.[13-15] Descriptive statistical analysis was done in our present study. For calculation of results on continuous measurements, mean ± standard deviation (minimum-maximum) was applied. Number (%) has been used to present results on categorical measurements. Assessment of significance was done at 5% level of significance. Analysis of variance test was carried out to analyze the significance of study parameters between three or more than three groups of

patients, student *t*-test (two-tailed, independent) has been applied to assess the significance of study parameters on continuous scale between two groups intergroup analysis on metric parameters. Leven1s test for homogeneity of variance has been carried out to assess the homogeneity of variance.

RESULTS

The present study was a randomized controlled study consisting of 60 mild-to-moderate cases of asthma, divided randomly into Group A (yoga training along with pharmacological therapy) and Group B (only pharmacological therapy). Table 1 shows the anthropometric parameters in both groups. Subjects in both the groups were well matched with respect to age, height, weight, and Body mass index (BMI). Table 2 shows that gender distribution was matched in both groups. Table 3 shows the pulmonary parameters recorded at baseline, after 4 weeks and after 8 weeks. The pulmonary parameters were well matched between both the groups at baseline. There is improvement of forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), FEV_1/FVC, peak expiratory flow rate (PEFR), forced expiratory flow rate 25–75% (FEF_{25-75}), specific airway conductance (sGAW) ($P < 0.001$), and significant reduction in RAW ($P < 0.001$) after 4th and 8th weeks of yoga practice in Group A as compared to Group B [Tables 1-3].

DISCUSSION

In this randomized controlled study using MEC PFT and body plethysmograph system, effort has been made to study the effect of yoga on PFTs in patients of the mild-to-moderate severity of bronchial asthma. Study group practiced yoga along with pharmacological therapy and control group followed only pharmacological therapy. As per Table 3, there is a significant improvement in pulmonary functions after 8 weeks of yoga training in the study group. FEV_1 and FVC in study group has significantly increased from baseline value of 2.06 ± 0.62 to 2.31 ± 0.66 ($P < 0.001$), and 2.87 ± 0.83 to 2.90 ± 0.82, respectively. FEV_1/FVC% has increased from 71.74 ± 5.38 to 79.95 ± 5.44 ($P < 0.001$). Increase in PEFR from 5.13 ± 1.57 to 5.26 ± 1.56. FEF_{25-75} improved from a baseline value of 2.82 ± 0.70 to 2.85 ± 0.70. Reduction of RAW from baseline value of 0.528 ± 0.19 to 0.512±0.19 ($P < 0.001$) after yoga sGAW improved from 1.02 ± 0.28 to 1.05 ± 0.28 in the study group whereas the control group did not show any significant change in FEV_1, FVC, FEV_1/FVC, PEFR, FEF_{25-75}, RAW, and sGAW over 8 weeks.

Table 1: Anthropometric parameters of the patients studied

Anthropometric variable	Group A	Group B	*P* value
Age (years)	32.67±8.69	31.00±9.03	0.553
Height (cm)	160.27±8.93	160.87±9.00	0.796
Weight (kg)	63.70±11.61	63.27±8.32	0.869
BMI (kg/m^2)	24.78±4.21	25.51±5.97	0.586

BMI: Body mass index

Table 2: Gender distribution of patients studied

Gender	Group A	Group B
	n (%)	*n* (%)
Male	10 (33.3)	10 (33.3)
Female	20 (66.7)	20 (66.7)
Total	30 (100.0)	30 (100.0)

Asthma is associated with an increase in RAW, decrease in forced respiratory volumes and flow rates, hyperinflation of the lungs and increased work of breathing. Yoga therapy readjusts the autonomic imbalance, controls the rate of breathing, relaxes the voluntary inspiratory and expiratory muscles reduces RAW and increases lung compliance.[6]

Our study is in agreement with Sodhi *et al*. and Singh *et al*. who have found similar results on pulmonary functions FEV_1, FVC and FEV_1/FVC% after the yoga training. Yoga therapy relaxes the voluntary inspiratory and expiratory muscles increases respiratory efficiency balances activity of opposing muscle groups and slows dynamic and static movements.[4] Yoga asanas and pranayama enhances the strength and endurance of respiratory muscles, diaphragm and upper abdominal muscles.[6] Regular practice of pranayama will lead to improvement in vital capacity due to increased development of respiratory musculature. Moreover, the respiratory apparatus is emptied and filled more completely and efficiently which is recorded in terms of FVC. The increase in FEV_1 might be due to a significant increase in vital capacity.[16]

This study is in agreement with study done by Nagarathna R *et al*. and Singh S *et al*. who studied the effect of yoga on bronchial asthma and found significant improvement in PEFR and FEF_{25-75} in yoga group. Yoga improves thoracic - pulmonary compliances and leads to bronchodilation. Stimulation of pulmonary stretch receptors by inflation of the lung reflexly relaxes smooth muscles of larynx and tracheobronchial tree, and this may modulate the airway caliber and reduces RAW.[17] Modification of vagal efferent activity by yoga therapy seems to affect calibre of airways.[7] Yoga appears to result in somatic muscular relaxation finally resulting in a reduction in RAW and increases compliance of the lung.[6] Yoga with its calming effect on the mind which could reduce the emotional stress and therefore withdrawing the bronchoconstrictor effects.[18]

Our study is in agreement with Lehman *et al*. who studied the effect of functional relaxation as complementary therapy

Table 3: Comparison of study variables in two groups at baseline, after 4 and 8 weeks

Variables	Groups	Baseline	Week 4	Week 8	*P* value
FEV_1(l)	A	2.06±0.62	2.16±0.64	2.31±0.66	<0.001**
	B	2.07±0.57	2.08±0.57	2.07±0.57	0.557
	P Value	0.942	0.599	0.133	
FVC (l)	A	2.87±0.83	2.88±0.82	2.90±0.82	<0.001**
	B	2.93±0.70	2.94±0.70	2.94±0.70	0.324
	P Value	0.742	0.748	0.836	
FEV_1/FVC%	A	71.74±5.38	74.84±5.08	79.95±5.44	<0.001**
	B	70.28±6.71	70.18±6.7	70.96±6.81	0.227
	P Value	0.360	<0.003**	<0.001**	
PEFR (l/s)	A	5.13±1.57	5.18±1.57	5.26±1.56	<0.001**
	B	5.03±1.59	5.08±1.61	5.02±1.58	0.405
	P Value	0.812	0.807	0.569	
FEF_{25-75} (l/s)	A	2.82±0.70	2.83±0.70	2.85±0.70	<0.001**
	B	2.92±0.64	2.94±0.65	2.93±0.65	0.133
	P Value	0.556	0.536	0.661	
RAW kPa (l/s)	A	0.528±0.19	0.516±0.19	0.512±0.19	<0.001**
	B	0.577±0.18	0.578±0.18	0.582±0.18	0.195
	P Value	0.308	0.193	0.085+	
sGAW (l/kPa/s)	A	1.02±0.28	1.03±0.28	1.05±0.28	<0.001**
	B	0.95±0.25	0.96±0.25	0.95±0.25	0.266
	P Value	0.264	0.236	0.163	

BMI: Body mass index, FEV_1: Forced expiratory volume in 1 second, FVC: Forced vital capacity, PEFR: Peak expiratory flow rate, FEF_{25-75}: Forced expiratory flow rate 25–75% of FVC, RAW: Airway resistance, sGAW: Specific airway conductance

in asthma and found that functional relaxation leads to a significant decrease in sRAW and significant improvement in FEV_1. Psychological treatment methods may influence airway caliber by balancing the activity of the autonomous nervous system. Mitigation of vagal stimulation rebalances autonomic system and is claimed to be responsible for bronchodilation and thereby reducing RAW.[8] Reduction in psychological hyperactivity and emotional instability achieved by yoga reduces efferent vagal reactivity.[7] During pranayama training, regular inspiration and expiration for prolonged period will help the lungs to inflate and deflate maximally and that it causes strengthening and increases the endurance of the respiratory muscles. This maximum inflation and deflation is an important physiological stimulus for the release of surfactants and prostaglandins into the alveolar spaces, which thereby increases the lung compliance. The stretch receptors reflexly decrease the tracheobronchial smooth muscle tone activity, which, in turn, causes decreased airflow resistance and increased airway caliber and reduces RAW.[19] This leads to an improvement in specific airway conductance.

Our study shows that there is a significant improvement in all the pulmonary parameters with regular practice of yoga techniques along with standard pharmacological treatment. Yoga reduces the bronchoconstrictor effects, increases lung compliance and respiratory endurance. Overall, yoga may have psychophysiological benefits by increasing the patient's sense of control over stress and thus helps in reducing their autonomic arousal factors. Yoga leads to an autonomic equilibrium with a tendency toward parasympathetic dominance rather than sympathetic dominance.[4] Yoga is a form of mind-body medicine, which promotes positive affect and reduces negative affect to improve pulmonary functions and reduce usage of bronchodilators in asthma patients.[20] Hence, reducing the health-care cost burden and improving the quality of life in bronchial asthma patients. Bronchial asthmatics should be motivated to practice yoga on a regular basis so as to reduce the symptoms and prevent further complications so that they can lead a better quality of life. The study was conducted on a limited sample over a short duration of time. There is scope for similar large-scale studies over longer duration so that yoga could be included as a part of the standard treatment regimen.

CONCLUSION

Regular practice of yoga improves pulmonary functions in mild-to-moderate cases of bronchial asthma, when used adjunctively with standard pharmacological treatment. Physicians may emphasize on regular practice of yoga along with pharmacological therapy in asthmatics. Awareness has to be created among asthma patients regarding usefulness yoga in the treatment of bronchial asthma.

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