Research article

Effect of comprehensive yoga therapy on pulmonary function among various groups with chronic obstructive pulmonary disease

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ABSTRACT

Introduction and Aim: COPD is a disease with involvement of multiple organ system. Our previous study has proved yoga to be useful in improving the lung function. The current study assesses the effect of yoga on lung function with respect to age, duration of illness and severity of disease due to COPD.

Materials and Methods: Thirty cases of COPD were recruited in this study. Cases were assessed for lung function, peripheral oxygen saturation and exercise tolerance by 6MWT. Patients were exposed to yoga within their capacity of feasibility, and assessed for above parameters at the end of each month for about three months. A comparison study of various parameters following yoga based on age, duration of illness and severity of disease was done applying independent t test. Variables were expressed as Mean±SD. P<0.05 was considered the threshold for statistical significance.

Results: there was an average increase in FEV1% by 5.2 in <65 years, compared to FEVI% by11.4 in >65yrs (p<0.05). FEV1/FVC (%) in both the age groups showed similar response following yoga intervention (p< 0.01 level). We did not get any significant results with duration of illness and severity of disease.

Conclusion: Regular yoga practice improves the lung parameters and also the respiratory muscle strength**.** In this study, COPD patients falling under higher age groups showed more of benefit with yoga. We could not elucidate any response in lung function following yoga based on duration of illness and disease severity. Yoga practice is useful in improving lung parameters in higher age groups. Regular practice of yoga has helped patients with relief from frequent exacerbation of respiratory symptoms.

Keywords: Yoga; COPD; lung function.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a disease with involvement of multiple organ system. Treatment of this ailment mainly focuses on reducing exaggeration of symptoms and maintaining quality of life. In COPD, exercise intolerance with compromised respiratory function is the worst among many that affect the quality of life. Hence physical training can be rewarding as suggested by many previous studies. Studies have shown that various breathing control exercises (BCEs) and respiratory muscle training (RMT) are being used to improve breathlessness(1). BCEs include manoeuvres like diaphragmatic breathing (DB), pursed-lip breathing (PLB), relaxation techniques (RT), and body position exercises (BPEs).

In our previous study, we found yoga to be useful in improving maximal expiratory pressure (MEP) and maximal inspiratory pressures (MIP) which invariably improved the symptoms to some extent and also improved the parameters of lung function (2).

Chronicity of any illness is marked by its age of onset and progression .On an average, the human lung grows by 10–12 years and matures further until maximum function is obtained by 20 years of age for females and 25 years for males(9). Lung function progressively declines with increasing age due to structural and physiological changes to the lung (3). Eventually changes occur in lung structure, chest wall and in respiratory muscles(4). The size of the alveolar space increases without any inflammation or alveolar wall destruction, reduced capacity of elastic recoil of the lung and progressive decrease in compliance of the chest wall. However in COPD, these changes will occur in general at an earlier age and to a larger extent compared to normal lung ageing. Studies following meta-analysis of epidemiologic data from 28 countries showed, that the prevalence of COPD based on spirometry is 9 to 10% in those over 40 years of age (5) whereas two to three times higher among persons over 60 years of age (6).

Understanding the compromised lung function in COPD, along with age related changes especially in elderly, we extrapolated our study from yoga on lung function in COPD, our previous study(2) to effect of yoga on lung function with respect to age, duration of illness and severity of disease due to COPD.

MATERIALS AND METHODS

COPD cases of 30 patients with different severity as defined in the Global Initiative for obstructive lung disease (GOLD) guidelines (7), were recruited who attended outpatient unit in department of the Respiratory medicine at Govt. T D Medical College Hospital, Alappuzha. None of the cases practiced yoga or any kind of exercises. The sample size was determined based on a previous study by Comparison of Two Mean $N= 2(Z\alpha +Z\beta)^2 \sigma^2/ \Delta^2$; Where Z_∞ = 1.96 for $\infty = 0.05$; $Z_\beta = 0.84$ for $\beta = 0.20$; $\Delta = \mu_T - \mu_C$ (difference in mean); σ = Standard deviation (8). In this study, pooled standard deviation, PEFR (σ) = 0.85, Difference in mean PEFR between yoga group and normal group (Δ) = 0.7 ; $N= \{2(1.96+0.84)^2 \times 0.85^2\}/(0.7)^2$ =24. A total of 30 cases were taken anticipating drop-outs during the study. The study protocol was approved by the institutional ethical committee at Government T. D. Medical College Hospital, Alappuzha. Informed consent was taken from the study group.

Inclusion criteria

COPD patients ("mild to severe" grades as per GOLD guidelines as shown in Table-1) with no prior history of any physical exercises. No history of any chronic medical illness or any surgery, no history of depression (Hamilton depression rating scale HAM-D-21 > 8, not included in the study according to DSM-V) (9).

Exclusion criteria

'Very severe' COPD grades of severity as per GOLD staging; smoking, chronic diseases like severe anaemia, electrolyte imbalance, tuberculosis, diabetes, coronary arteries disease. Patients who do exercises regularly or indulged in exercises within six months before intervention.

Following parameters of respiratory system was assessed:

Spirometry-FVC (L), FEV1 (L), PEFR (L/sec). FEV1/FVC ratio (%) using an electronic spirometer (SPIROPALM 6 MWT comply with ATS/ERS guidelines) was used. The COPD patients with post-bronchodilator (20 min after inhalation of 2 puffs of salbutamol given via a metered dose inhaler through a spacer) FEV_1 less than 80% of the predicted value along with an FEV_1/FVC % not more than 70% were taken into the study.

Peripheral oxygen saturation (SpO2)-The resting oxygen saturation assessed using the pulse oximetry (NONIN) with placing probe in left index finger. Spo2 was assessed before and after yoga intervention.

Health status of the patients was assessed by CAT COPD assessment test questionnaire (≥ 10 as an indicator of more symptoms; 10).

Exercise tolerance by 6 minute walk test (6MWT) - The distance the patient was able to walk in 6 min was determined in a measured corridor under the supervision of a doctor. The test was performed twice, and the best reading was reported (11).

Grade of dyspnea (D) assessed by the modified Medical Research Council (mMRC) Dyspnea Scale (Bestall *et al.*,); (≥ 2 as an indicator of more symptoms) (12).

Maximum inspiratory pressure, MIP (or PImax) and Maximal expiratory pressure, MEP (or PEmax), is a non-invasive procedure done using portable digital peak respiratory pressure (DPRP) (13). It helps to assess inspiratory and expiratory muscle strength. The device used was DPRP which works on the principle of pressure transducer converting the pressure in the mouthpiece into voltage. Voltage is calibrated as 1mm Hg = 10 mV.

Yoga practices

Patients were taught yoga practice by a certified yoga therapist in Shivananda yoga. The practice involved breathing exercises, meditation, and yoga postures, Yoga was taught within the premises of department of pulmonary medicine at the medical college hospital itself for one month for ease of conveyance for the patients. All patients were instructed to continue their prescribed medical treatment for COPD during the study.

All the above parameters were assessed before the commencement of yoga practice and again repeated at the end of one month. Patients who did not suffer any exacerbations of symptoms during or after yoga practice were only asked to continue the practices at home in the vicinity of a bystander, who was instructed to keep a diary about their daily yoga practices and the duration of time. Patients were also instructed to keep a record about their symptoms, hospitalization other than the regular check-up and the medications other than the usual dose, taken for the disease COPD. They were strictly instructed to abstain from yoga practice during any acute exacerbation of their respiratory symptoms. The medication for COPD were kept the same throughout the study period for all the groups. The study group, then were asked to visit the principal investigator once a week to give report about their health status.

Above mentioned parameters were assessed at the end of each month for about two months. Additionally, patients were told to keep nutritious eating regime and adequate sleep (7-8 hours/day).

Training in yoga

The yoga practice was continued for 3 months as part of the study. It included pranayama and asanas. The regime included relaxation of external body 5 min, *pranayama* (25min), asanas (15min), *shavasana* final relaxation (5 min), meditation (5 min) along with lifestyle changes (14).

Pranayama (breathing exercises):
Bhastrika:, Anulom vilom:, kapalbhati:, bhramari.

Asanas (postures): *Surya namaskar, tadasana, sukhasana, paschimotasana, padahasthasanam, bhavanamuthasanam, vrikshasanam, bhujangasanam, matsyaasanam, shalabhasanam, makarasanam,* butterfly, *vajrasanam.* (different sets of asanas per session considering the flexibility and safety of patients).

Shavasana: 5min.

Since patients fall in varied grades of COPD as per the severity, not all were able to do all *asanas.* Patients were trained to do these practices within their capacity and feasibility at their comfort. Although after few sessions, improvement was seen in attempting the asanas and also selecting floor over the chair while practicing the yoga *asanas.* Besides having trained in the above asanas, they were also provided with videotape or pamphlets of yoga asanas to practice at home. They were asked to document the number of sessions and time duration of home practice during each yoga class session.

Safety and feasibility

Safety of the yoga program was assessed by measuring heart rate, oxygen saturation (SpO2), and dyspnea (MMRC) before and after each yoga session. Feasibility was assessed by interviewing perceived difficulty and level of enjoyment after each session. Patients were asked about their satisfaction and experiences with the program during individual exit interviews.

Statistical analysis

A comparison of increase in various parameters following yoga based on age, duration of illness and severity of disease was done using independent t test. Variables were expressed as Mean±SD. $P<0.05$ was considered the threshold for statistical significance. Statistical analysis was performed using a statistical software package SPSS version 20.0.

RESULTS

The study group of COPD patients were selected and grouped as per the GOLD staging (Table1).

The mean age group of COPD cases was 66 yrs. We divided the groups with age less than 65 years and more than 65 years group. On comparison of lung parameters in different age groups of COPD following yoga sessions (Table 2), It was found that the average increase in FEV1% was 5.2 as a result of Yoga intervention in age group below 65 years, whereas an average increase of FEVI% was11.4 among patients of age greater than 65yrs. The independent t test shows that the increase in FEVI as a result of the intervention is significantly high among patients of age greater than 65 as compared to patients less than 65 years, which was statistically significant at ($p<0.05$). For FEV1/FVC (%), both the age groups showed similar response following yoga intervention which was statistically significant at $p< 0.01$ level.

For all the other parameters following yoga, responses were independent of their age group. The mean duration of illness of COPD patients were 7 yrs. They were grouped into two groups, with duration of illness less than 5yrs and more than 5 yrs. On comparison of effect of yoga on various parameters based on duration of illness (Table 3), the response obtained was independent of duration of illness.

Based on severity of disease, patients were grouped into two groups, "mild/ moderate" and "severe" groups (Table 4). Here too in lung parameter responses in the two groups following yoga were independent of the severity of the disease.

Table1: Classification of COPD by impairment of lung function

Stage	COPD	Spirometry (postbronchodilator)
GOLD 1	Mild	FEV1 >80% predicted, FEV1/FVC <0.7
GOLD 2	Moderate	50% ≤ FEV1 < 80% predicted, FEV1/FVC <0.7
GOLD 3	Severe	30% ≤ FEV1 < 50% predicted; FEV1/FVC <0.7
GOLD 4	Very severe	FEV1<30% predicted; FEV1/FVC <0.7

Table 2: Comparison of increase in various parameters following yoga based on age

Variables	Age ≤65yrs		Age >65yrs			P value
	Mean± SD	N	Mean± SD	N	t value	
FEV1 (%)	5.2± 8.5	17	11.4±7.0	24	2.52*	0.016
PEFR (L/MIN)	2.5±12.1	17	6.2±12.2	24	0.97	0.338
FVC (L)	3.4±19.0	17	2.2±11.0	24	0.26	0.799
FEV1/FVC (%)	0.1±0.1	17	0.1±0.1	24	3.01**	0.005
MMRC	-0.7±0.8	17	-0.5±1.0	24	0.84	0.405
CAT	-3.2±5.3	17	-3.3±5.0	24	0.03	0.972
MIP Pressure (mm Hg)	20.1±10.4	17	16.5±12.1	24	1	0.325
MEP pressure (mm Hg)	26.1±13.9	17	20.3±11.5	24	1.46	0.152
SPO2 (%)	0.2±0.8	17	0.4±0.7	24	0.61	0.549
6MWT (meter)	11.8±57.4	17	21.8±79.2	24	0.44	0.660
SPO2 desaturation %)	0.2±2.0	17	0.1±1.3	24	0.1	0.919

Values expressed as Mean ±Standard deviation; **Significant at 0.01 level, *Significant at 0.05 level

Table 3: Comparison of increase in various parameters following yoga based on duration of disease

Variables	Age <5 yrs		Age ≥5yrs		t value	P value
	Mean± SD	N	Mean± SD	N		
FEV1 (%)	10.1±8.4	20	7.7±8.0	21	0.93	0.358
PEFR (L/MIN)	8.0±10.9	20	1.5±12.6	21	1.74	0.09
FVC (L)	7.1±16.5	20	-1.4±11.6	21	1.91	0.063
FEV1/FVC (%)	0.1±0.1	20	0.1±0.1	21	1.84	0.073
MMRC	-0.7±1.0	20	-0.4±0.9	21	0.94	0.353
CAT	-2.8±4.3	20	-3.8±5.7	21	0.64	0.526
MIP Pressure (mm Hg)	17.5±12.6	20	18.4±10.4	21	0.27	0.787
MEP Pressure (mm Hg)	25.4±7.8	20	20.1±15.9	21	1.33	0.19
SPO2(%)	0.2±0.7	20	0.5±0.7	21	1.47	0.151
6MWT (meter)	3.5±50.1	20	31.0±84.4	21	1.26	0.214
SPO2 Desaturation (%)	-0.1±1.4	20	0.4±1.7	21	0.98	0.334

Values expressed as Mean ±Standard deviation

Table 4: Comparison of increase in various parameters following yoga based on severity of disease

Variables	Mild/Moderate COPD		Severe COPD		t value	P value
	Mean± SD	N	Mean± SD	N		
FEV1 (%)	7.4±4.1	11	9.4±9.3	30	0.69	0.495
PEFR (L/MIN)	4.4±15.1	11	4.8±11.2	30	0.09	0.926
FVC (L)	3.6±17.1	11	2.4±13.9	30	0.24	0.809
FEV1/FVC (%)	0.1±0.1	11	0.1±0.1	30	1.47	0.15
MMRC	-0.7±1.3	11	-0.5±0.8	30	0.69	0.492
CAT	-4.2±5.4	11	-2.9±4.9	30	0.7	0.488
MIP Pressure (mm Hg)	15.9±11.4	11	18.7±11.5	30	0.69	0.494
MEP Pressure (mm Hg)	26.9±8.2	11	21.2±13.8	30	1.29	0.205
RSO2 (%)	0.2±0.8	11	0.4±0.7	30	0.72	0.475
6MWT (meter)	36.4±86.9	11	10.7±63.6	30	1.03	0.307
RSO2 Desaturation (%)	0.2±0.9	11	0.1±1.8	30	0.09	0.932

Values expressed as Mean ±Standard deviation

DISCUSSION

Yoga represents a form of mind-body fitness. Yogic practices include a combination of *asanas, pranayama,* meditation and relaxation. Yoga works mainly on breathing pattern helping one to be aware of controlled breathing. There are lot of benefits studied following regular yoga practice. Improving skeletal muscle tone, respiratory muscle strength, mental calm, enhancing and improving energy levels and lung expansion (15). There are studies that had demonstrated that slow breathing pattern helps patients breathe more deeply by efficiency of the shoulder, thoracic, and abdominal muscles, this lead to an increase in parasympathetic modulation and regulation of chemoreceptor sensitivity(16). Sympathetic activity decreases promoting broncho-dilatation and reducing muscle tension in inspiratory and expiratory muscles improving symptoms like dyspnea (16). Regular practice of *pranayama* helps in stretching lung tissue, alleviates dyspnea enhances respiratory muscles' strength and endurance and optimizes thoracoabdominal patterns of motion (17).

Apart from yoga asanas relaxation practices in yoga improves cardiopulmonary endurance through breath control, which helps in improved lung capacity, better oxygen delivery and normal & regular heart rate, resulting in overall improved exercise capacity. Controlled breathing also optimizes thoracic abdominal motions during breathing and reduces tachypnoea(18).The effect of yoga on COPD is consistent with conclusions of various other studies(19). In our previous study too we have demonstrated that regular yoga practice had improved the lung parameters and also the respiratory muscle strength(2). In this study, we aimed at assessing if there is any improvement in COPD illness seen with various age groups, duration of illness and severity of disease. We noticed that COPD patients falling under higher age groups showed more of benefit with yoga as reflected in improved lung parameters FEV1 %, whereas the FEV1/ FVC %, showed equal response in both age groups. There were no studies found to substantiate our findings especially in south India.

Although there are studies demonstrating that yoga caused improvement in body balance in geriatric population(20-22). Similar results have been obtained in a study by Goncalves *et al.*, where data was collected from 83 elderly yoga practitioners of age 60yrs and above, and found a remarkable improvement in joint flexibility than their control(23). These findings suggest that be it any age, regular practice of yoga can bring about remarkable improvement in health status and quality of life.

We did not find any difference in lung parameters attributing to oxygenation, lung function, thoracic muscle strength and exercise tolerance in any of COPD patients grouped in terms of duration of illness or severity of the disease. This might be due to low sample size and relatively short duration of overall yoga intervention.

COPD being a chronic disease causing physical inactivity, with more viable lung tissue, better will be the health response with yoga and similar physical activities that focusses more on controlled breathing patterns. More of studies are required in future to understand how yoga can be helpful in different age groups and also with the other risk factors associated with development of the disease. We also need to compare the responses using various forms of physical training with yogic practices.

Limitations

Our study has few limitations like small sample size. A comparison between multiple groups would have explained the outcome in a better way.

CONCLUSION

We conclude that yoga practice can be useful in improving lung parameters in higher age groups. Regular practice of yoga is helpful in improving the physical health status and improving the symptoms. Our study extends the scope of further inclusion of similar yoga training program with widespread age group, and patient grouped on the basis of other risk factors associated with COPD.

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CONFLICT OF INTEREST

The authors report no conflicts of interest in this work.

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