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Original Article

Physiology Section

# The Short Term Effect of Pranayama on the Lung Parameters

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## ABSTRACT

**Introduction:** Yoga is a science which has been practised in India from over thousands of years. Besides its spiritual achievements, the practice of yoga is accompanied by a number of beneficial physiological effects in the body. Pranayama is an art of controlling the life force of breath. It produces many systemic psycho-physical effects in the body, besides its specific effects on the respiratory functions. This study is designed to study the effects of short- term pranayama (6 weeks) on the pulmonary function parameters.

**Methods:** The study group consisted of 50 young adults (26 males and 24 females) who were newly recruited for yoga training at the Patanjali Yoga Center, Kolar. They were motivated to undergo pranava, Nadishuddi and Savitri Pranayama training for 1 hour daily, for 6 days a week. The first phase of the recording of the pulmonary parameters was done at the beginning of their course. The second phase of the recording was done after 6 weeks of the regular pranayama practice.

**Results:** The FVC - before pranayama showed a value of 2.60±0.40 and after pranayama, it showed a value of 3.20±0.43. The FEV1- before pranayama showed a value of 2.36±0.36 and after pranayama, it showed a value of 2.96±0.42. The PEFR - before pranayama showed a value of 6.09±1.03 and after pranayama, it showed a value of 7.38±1.12. The FEF (25%-75%) - before pranayama showed a value of 2.93±0.47 and after pranayama, it showed a value of 3.74±0.45. The BHT – before pranayama showed a value of 38.34 ±4.34 and after pranayama, it showed a value of 56.62±9.01. For all the parameters, a P value of <0.001 was considered as statistically significant.

**Conclusion:** There was a statistically significant increase in all the above lung parameters in the regular yoga practitioners. Pranayama is a type of yogic breathing exercise. This resultant effect of pranayama can be used as a lung strengthening tool to treat many lung diseases like asthma, allergic bronchitis, post pneumonia and tuberculosis recoveries, and many occupational diseases.


**Key Words:** Pranayama, Yoga, Pulmonary Function Parameters FVC FEV1 $FEF_{(25-75\%)}$, BHT

## INTRODUCTION

Yoga is a science which has been practised in India from over thousands of years. It is one of the best lifestyle modifications which have ever been devised in the history of mankind. There are many classical paths which have been described to reach the ultimate goal of healthy life. Besides the spiritual achievements, the practice of yoga is accompanied by a number of beneficial physiological effects in the body. Yoga and health goes hand in hand. Yoga calms and relaxes the mind and it strengthens and tunes the body and brings them into harmony with each another.

Pranayama is an art of controlling the life force of breath [1]. It is an ancient yoga technique, a spiritual and physical practice which integrates the mind and body. Pranayama is a type of yogic practice which produces many systemic psycho-physical effects in the body, besides its specific effects on the respiratory functions. So, it has become a standard fare at health clubs and community recreation programmes.

Pulmonary function tests (PFTs) are simple screening procedures which are performed by using a standardized equipment (spirometer) to measure the lung function. This test provides useful information about the minimum levels of the lung function. The breath holding time measures the level of the threshold of the respiratory center to the partial pressure of the carbon dioxide ($Pco_2$) level.

Pulmonary function tests have been studied in yoga and pranayama practitioners. They have shown that the regular practice of these long-term pranayama techniques have proved to be beneficial for the human body. Pranayama has a favourable influence and it causes a marked improvement in the lung functions. This study is designed to study the effects of short- term pranayama (6 weeks) on the pulmonary function parameters.

## MATERIALS AND METHODS

The study group consisted of 50 young adults (26 males and 24 females) who were newly recruited for yoga training at the Patanjali Yoga Center, Kolar, Informed consent was taken from all the subjects who volunteered for the study. They were motivated to undergo pranava, Nadishuddi and Savitri Pranayama training for 1 hour daily, for 6 days a week. The first phase of the recording of the pulmonary parameters was done at the beginning of their course. The second phase of the recording was done after 6 weeks of the regular pranayama practice. The practice of pranayama was for 1 hour a day in the morning (6.30 am to 7.30 am), for six days per week. All the subjects were compulsorily asked to have a balanced vegetarian diet. They initially performed stretching exercises for 10 mins before starting the pranayama. The subjects sat in Padmasana. The left arm was held straight and it was placed on the left knee. All the three types of Pranayama i.e. Pranava, Nadi shuddi and Savithri Pranayama were done one after the other. Each one was done for 10 rounds.

## INCLUSION CRITERIA

Young healthy subjects who were aged between 18-35 years.

## EXCLUSION CRITERIA

The subjects with a history of

1. Allergic disorders or respiratory disorders.
2. Smoking.
3. Systemic disease like diabetes, hypertension and collagen disorders.
4. Treatment with beta-agonists or the xanthenes group of drugs.
5. Chest deformities like kyposis and scoliosis.

Systemic diseases and respiratory disorders were ruled out in the selected subjects by taking their detailed history and by their thorough clinical examination.

### Anthropometric measurements which were recorded

- Age was calculated in years to the nearest birthday.
- Height was measured in centimeters while standing. The reading was taken nearest to ½ cm.
- Weight was recorded in kilograms; the reading was taken nearest to ½ kg and the weighing machine was appropriately calibrated from time to time.

The pulmonary function tests were determined by using a Medspiror model (computerised spirometry) and the breath holding time was measured by using a stop clock.

### Pulmonary function tests

The pulmonary functions were tested by using the instrument, 'Medspiror' (a self calibrating computerized spirometer that fulfills the criteria for standardized lung function tests), which was available in the Department of Physiology, SDUMC. The pulmonary functions were tested at the start of the course and after 6 weeks. The parameters which were studied were,

- Forced vital capacity (FVC)
- Forced expiratory volumes ($FEV_1$ )
- Peak expiratory flow rate (PEFR)
- Forced expiratory flow 25-75 % (FEF 25-75%)

### The procedure

The subjects were familiarized with the set up and detailed instructions and demonstrations were given for our satisfaction. The subjects were made to breathe out forcefully, following deep inspiration, into the mouthpiece which was attached to the pneumatachometer. The expiration was maintained for a minimum period of 3-4 seconds. 3 to 4 trials of maximal inspiratory and expiratory efforts were made and only the highest reading was taken for data processing.

As recommended by Snowbind's workshop, all the readings were taken with the subjects in the standing position [2].All the tests were carried out at the same time of the day, between 8.30 am to 9.30am, to avoid the possible variations, because rhythmic changes in the physiological functions were found to be associated with changes in the performance during this period [3].

The tests were done in a quiet room in order to alleviate the emotional and psychological stresses. During the tests, a maximum effort from the subjects was ensured by adequately motivating them to perform at their optimum level. A normal PEFR value of 3-5 L/sec ensured a maximum effort by the subject while performing the test.

## BREATH HOLDING TIME RECORDING

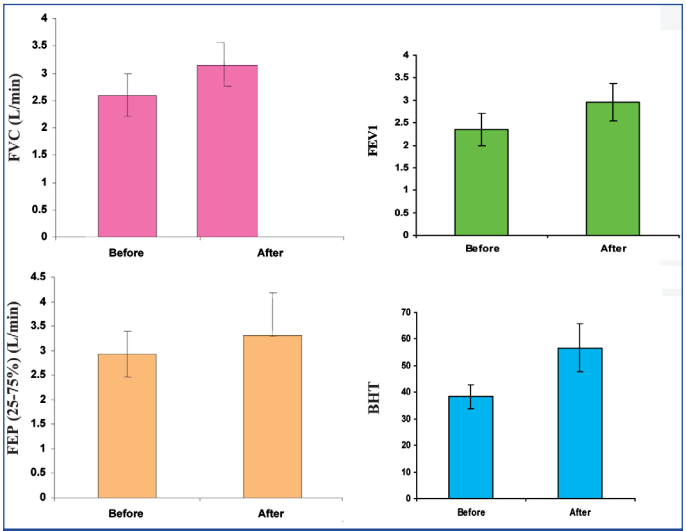
**Procedure:** The subject was asked to hold his/her breath while in the sitting posture. The breath was maintained until the subject could no longer hold the breath voluntarily and the time was noted by using a stop watch. This recorded the BHT.

## RESULTS AND ANALYSIS

An evaluation of a non-controlled study with 50 adult subjects was undertaken to study the effect of 6 weeks of pranayama on the lung parameters. The mean age of the study group was 25.76 ± 5.51years (mean ± SD). A P value of <0.005 was considered significant. The first phase of the recordings in the study group was taken at the beginning of their course. i.e., before starting the Pranayama practice and the second phase of the recordings was taken after 6 weeks of regular practice of Pranayama. Statistical software: The Statistical software, namely SAS 9.0, SPSS 15.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel were used to generate graphs, tables, etc [8,9,10,11].

| Variables | Before | After | P value | Effect size |
|---|---|---|---|---|
| FVC (L/min) | 2.60±0.40 | 3.20±0.43 | <0.001** | 1.43 |
| FEV1 (L/min) | 2.36±0.36 | 2.96±0.42 | <0.001** | 1.54 |
| PEFR(L/sec) | 6.09±1.03 | 7.38±1.12 | <0.001** | 1.19 |
| FEF (25-75%) (L/min) | 2.93±0.47 | 3.74±0.45 | <0.001** | 1.75 |
| BHT(sec) | 38.34±4.34 | 56.62±9.01 | <0.001** | 2.74 |

**[Table/Fig-1]:** Comparison of effect of 6 weeks pranayama on lung parameters.




**[Table/Fig-2]:** FVC (L/Min), FEV1 (L/Min), FEF (25-75%), BHT (sec) graphical comparison of effect of 6 weeks pranayama on lung parameters

## DISCUSSION

Pranayama is a type of yogic breathing exercise. It is a form of physiological stimulation. The regular practice of Pranayama is a form of adaptation to a repeated stimulus. Breathing is the only autonomic function that can be consciously controlled and it is the key in bringing the sympathetic and the parasympathetic nervous system into harmony [12]. Breath is the only function through which we can influence the involuntary nervous system, i.e. we can establish rhythms of breathing with our voluntary nerves and muscles, which will affect the involuntary nervous system [13].

The pulmonary function test (PFTs) is a valuable tool for evaluating the respiratory system. It is a simple screening procedure which

can be performed by using standardized equipment to measure the lung function [14].

Pulmonary function tests have been studied in yoga and pranayama practitioners. They have shown that the regular practice of these long-term pranayama techniques have proved to be beneficial for the human body and that it also improved the breath holding time [15,16]. This study is designed to know the effect of short-term pranayama (6 weeks) techniques on the pulmonary function parameters.

In our study, the PFT values were recorded in young healthy subjects before and after 6 weeks of pranayama .The pulmonary function parameters FVC, FEV1, PEFR, FEF25-75% and Breath holding time (BHT) were found to be significantly increased. These results were consistent with those of other studies which were done by Yadav A et al. [17], Upadhyay KD et al. [18] andChanavirut et al. [19].

All these studies have explained that, during pranayama training, regular inspiration and expiration for prolonged period leads the lungs to inflate and deflate maximally and that it causes strengthening and increased endurance of the respiratory muscles [4,5,6,7]. This maximum inflation and deflation is an important physiological stimulus for the release of surfactants and prostaglandins into the alveolar spaces, which thereby increase the lung compliance [20,21]. The stretch receptors reflexly decrease the tracheo-bronchial smooth muscle tone activity, which leads to decreased air flow resistance and increased airway caliber, which causes the dynamic parameters of the lung function test to improve.

A study showed that after 2 weeks of the pranayama practice, the FVC, FEV1, FEF 25-75% and the PEFR values had improved in the subjects. In our study, a greater improvement of the pulmonary parameters was observed. This may be because our subjects were young, healthy adults (mean age group -25.76± 5.51 years) who had practised pranayama for 6 weeks [22].

A study by Bhargava MR et al. showed a statistically significant increased breath holding time after the pranayama practice. The same study explained that during pranayama training, regular inspiration and expiration for longer duration would lead to acclimatization of central and peripheral chemoreceptors for both hypercapnoea and hypoxia [23]. Acclimatization of the stretch receptors of the chest, the bronchial walls and the alveoli increase the synchronization between the lung tissue and the cortex. The prolonged inhalation in pranayama leads to an increased breath holding time [24,25].

A study by Upadhyay A et al. in which the pranayama practice was conducted for a duration of 4 weeks, showed increased PEFR, whereas in our study, with 6 weeks of pranayama practice, the PEFR values showed greater improvement [18]. This showed that as the duration of the pranayama increased, the pulmonary function test parameters also increased proportionately.

It was observed in another study by Bhavani et al. that pranayama produced immediate and significant reduction in the auditory and visual reaction time, indicating an improved sensory motor performance and an enhanced processing ability of the central nervous system [26].

A study by Ravindra et al. on patients with premature ventricular complexes (PVC) and episodes of palpitations, found that pranayama produced an immediate relief in the palpitations and PVC. This improvement could have been because of the reduction of the sympathetic reactivity which was attained by the pranayama training [27].

## CONCLUSION

Pranayama is an ancient yoga technique. The regular practice of Pranayama integrates the mind and the body. It differs from other forms of exercises as it mainly focuses on the sensations in the body. Pranayama thus acts directly on the various functions of the body and affords benefits in a positive way. Our study showed that the pulmonary function test values improved after short term (6 weeks) pranayama practice. The following may be the reasons for this:

- Regular, slow and forceful inspiration and expiration for a longer duration during the pranayama practice, leading to strengthening of the respiratory muscles.
- Pranayama training causes improvement in the expiratory power and decreases the resistance to the air flow in the lungs.
- Pranayama training causes an increase in the voluntary breath holding time. This may be due to acclimatization of the chemoreceptors to hypercapnoea.

Pranayama is a type of yogic breathing exercise. This resultant effect of pranayama can be used as lung strengthening tool to treat many lung diseases like asthama, allergic bronchitis, post pneumonia recoveries, tuberculosis and many occupational diseases. Breathing is an autonomic function that can be consciously controlled and it is the key in bringing the sympathetic and the parasympathetic nervous system into harmony. The multi system benefits of pranayama can be used to treat multisystem disorders like diabetes and hypertension.

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