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RESEARCH ARTICLE

Effect of *Bhastrika pranayama* on pulmonary functions of elderly subjects

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ABSTRACT

Background: In old age, the expansion of lungs is restricted as the elastic tissue in the lungs is being replaced by fibrous tissue and a number of alveoli break down leading to emphysema, and also respiratory muscles become weak. Regular practice of pranayama should produce a positive effect on the lungs by increasing the pulmonary capacity and thereby improving the lung functions. **Aims and Objectives:** The purpose of this study was to investigate the pulmonary function in volunteers after 6 weeks training in *Bhastrika pranayama*. **Material and Methods:** This study was carried out on 40 healthy male volunteers in the age group between 60 and 70 years. The pulmonary function tests (PFT) were recorded with the RMS-Helios 702 spirometer. The parameters of PFT taken into account were forced vital capacity, forced expiratory volume in one second, peak expiratory flow rate. The PFT were compared before starting *Bhastrika pranayama* and after completing 6 weeks regular practice of *Bhastrika pranayama*. The paired and unpaired *t*-test were used at appropriate places as a statistical test. The value of $P < 0.05$ was considered statistically significant. **Result:** A significant increase in pulmonary functions were observed after the 6 weeks practice of *Bhastrika pranayama*. **Conclusion:** Regular practice of *Bhastrika pranayama* may tend to improve the strength in the respiratory musculature which leads to an improvement in the lung functions in them. Moreover, hence better the lung function in old age better the quality of life.

KEY WORDS: *Bhastrika Pranayama*; Pulmonary Functions; Forced Vital Capacity; Peak Expiratory Flow Rate

INTRODUCTION

With aging physiological changes occur in all organ systems. Arteriosclerosis develops in the arteries leads to increase in blood pressure, also cardiac output decreases. The renal function also decreases. In gastrointestinal system, motility is altered and atrophic gastritis occurs. The respiratory system is no exception to these changes, the lungs show impaired gas exchange, a decrease in vital capacity and slower expiratory flow rates.[1]

Exercise performed regularly is beneficial to the body not only in adults but also in older age group as it increases more nutrients and oxygen to the various organs of the body, thus improving their functions.[2] There are studies in the past to show that regular physical activity slows the rate of decline of most of the physiological parameters that we associate with health and fitness-*viz* muscle strength, aerobic capacity, reaction time, and joint flexibility.[3]

Sometimes in old age, due to immobility at joints, regular physical exercise is not possible. But to have a good quality of life, the lungs can be kept functional. This can be possible if regular breathing exercise can be done.

Pranayama if done regularly can be good breathing exercise to the respiratory system. "Pranayama is control of Breath". "prana" is Breath or vital energy in the body. On subtle levels, prana represents the pranic energy responsible for life or life force, and "ayama" means control. Hence, pranayama is "control of breath". One can control the rhythms of pranic energy with pranayama and achieve healthy body and mind. There are a few studies conducted in the past on the effect

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of yoga on pulmonary functions in the adult population. However, there are hardly any studies on the effect of *Bhastrika pranayama* on the pulmonary function, and that is effect on the elderly population of society. Yoga breathing exercises used adjunctively with standard pharmacological treatment significantly improves pulmonary functions in patients with bronchial asthma. It may be beneficial in treating stress-related disorders, such as anxiety and depression.[4]

The word "*Bhastrika pranayama*" is comes from the Sanskrit word Bhastrika, which basically means breathing like a bellows. Bellows is a device for producing a strong current of air which was used to fan fire in Ancient days. In *Bhastrika pranayama*, our lungs are moved with movements that are very much similar to the bellows. Hence, the *Bhastrika pranayama* is called the "bellows breath". Bhastrika (bellow-breathing) is a powerful and energetic Pranayama in yoga breathing exercises.[4]

In the *Bhastrika pranayama*, inhalation and exhalation both are forced. The movement of belly along with every breath is an optional variation. Hence, *Bhastrika pranayama* is all about inhaling and exhaling completely so that our body gets sufficient amount of oxygen. This rhythmic inhalation and exhalation stimulate the circulation of cerebral fluid, creating compression, and decompression in the brain. Rhythmic diaphragm movements stimulate heart and lung muscles improving blood circulation.[4] The purpose of this study was therefore to investigate the pulmonary function in volunteers after 6 weeks training in *Bhastrika pranayama*.

MATERIALS AND METHODS

This study was conducted on 40 healthy male volunteers who were in the age group of 60-70 years and who regularly practice *Bhastrika pranayama* for 5 min regularly over 6 weeks. The experimental protocol was explained to them and written consent obtained. All the procedures were non-invasive and the study plan was approved by the Ethics Committee of Index Medical College Hospital and Research Centre, Indore. All the subjects were healthy and free from any cardiorespiratory ailments and were not on any medication. Smokers, patients with diabetes, hypertension, and chronic respiratory problems such as asthma, tuberculosis were also excluded from the study. Moreover, their physical characteristics such as height, weight, and age, which have a role to play in determining the lung volumes, have been taken.

Bhastrika pranayama was done in sitting posture and subject followed the following instructions: (i) Sit in a meditative pose or in a comfortable position on the floor, (ii) keep the back straight and shoulder muscles relaxed, (iii) close the right nostril with your right thumb and bring your right elbow to the level of right shoulder, (iv) close your eyes, inhale and exhale through left nostril-first slowly, then a little faster, (v) do the above steps about 20-25 times, (vi) take a long breath in and retain it for as long as possible, (vii) this is one round of *Bhastrika pranayama*. Now, repeat this round by closing your left nostril and breathing through your right nostril. This can be done daily for 5 min over a period of 6 weeks.

Pulmonary function tests (PFT) was recorded by RMS-HELIOS 702 made in India (Chandigarh)-a computerized spirometer. The parameters of PFT included in the study were - Forced vital capacity (FVC), Forced expiratory volume in one second (FEV1) and peak expiratory flow rate (PEFR). All parameters were recorded during morning hours 7.30-9.30 am. The subjects were made familiar to the machine and were taught its usage. After repeated practice of using the machine, their PFT were recorded. The subjects were instructed to inhale and exhale normally and then after taking a forced inspiration, they were asked to expire forcibly into the nozzle of the machine. Three readings of all the tests were recorded and the best of the three was considered. The parameters taken into account in this study were FVC, FEV1 and PEFR.

Each of them was given half an hour rest before conducting PFT. Each subject was given two trials and three test runs for each test and best of the three test readings was taken.

Statistical Analysis

The results of PFT are presented as mean ± standard deviation. The data were analyzed using Student's *t*-test. The values of $P < 0.05$ were considered statistically significant.

RESULT

The PFT were studied in 40 male volunteers of Indore city that formed the study group. The range of age of volunteer was from 60 to 70 years. The results were tabulated and statistically analyzed. To test whether there was any significant difference with reference to the study variables between the study groups, paired *t* and unpaired *t*-test was used at appropriate places as a statistical test. As depicted in Table 1, FVC before (doing *Bhastrika pranayama*) was 2.09 ± 0.11 L and FVC 6 weeks after (doing *Bhastrika pranayama*) was 2.23 ± 0.12 L. Moreover, the difference between two were found to be statistically significant ($P = 0.0001$). FEV1 Before (doing *Bhastrika pranayama*) was 1.46 ± 0.07 L and FEV1 6 weeks after (doing *Bhastrika pranayama*) was 1.56 ± 0.08 L. Moreover, the difference between two was found to be statistically significant ($P = 0.0001$). PEFR before (doing *Bhastrika pranayama*) was 4.8880 ± 0.1652 L/sec and PEFR 6 weeks after (doing *Bhastrika pranayama*) was 5.2220 ± 0.1982 L/sec. Moreover, the difference between two was found to be statistically significant ($P = 0.0001$).

Table 1: Comparison of pulmonary function before and 6 weeks after doing *Bhastrika pranayama* (*n*=40)

Parameters	Before doing *Bhastrika pranayama*	6 weeks after doing *Bhastrika pranayama*	*P* value
FVC (L)	2.09±0.11	2.23±0.12	0.0001*
FEV1 (L)	1.46±0.07	1.56±0.08	0.0001*
PEFR (L/sec)	4.8880±0.1652	5.2220±0.1982	0.0001*

Data presented are mean±SD, *$P < 0.05$: Significant, FVC: Forced vital capacity, FEV1: Forced expiratory volume in one second, PEFR: Peak expiratory flow rate, SD: Standard deviation

DISCUSSION

The results discussed above clearly indicates that there is a decrease in the pulmonary functions in old age due to a decrease in the static elastic recoil of the lung, a decrease in compliance of the chest wall and a decrease in the strength of respiratory muscles. The expansion of lungs is restricted as the elastic tissue in the lungs is being replaced by fibrous tissue, and a number of alveoli break down leading to emphysema. The ribs and vertebral joints are variably calcified. Moreover, the muscles of respiratory cage-diaphragm, intercostals, and scalini contract poorly. All these changes account for lower efficiency in the elderly.[5]

Furthermore, from the results, it clearly indicates that the 6 weeks of *Bhastrika pranayama* training had higher values of lung functions. Similar studies carried out in the past have recorded similar observations.[6,7]

The increase in FVC is due to increased strength in respiratory muscles, i.e., particularly in the diaphragm.[8] Regular practice of *Bhastrika pranayama*, the lungs are filled and emptied more completely and efficiently which is recorded in terms of increased FVC. Similar is the mechanism in the elderly subjects (age 60-75 years), that has been shown to improve lung functions.[9] Makwana et al. also showed increased FEVl after 10 weeks of yogic practice. The increase in FEVl might be due to a significant increase in vital capacity. Joshi et al. reported a significant increase in FVC and PEFR following 6 weeks of pranayama practice.[10]

There is the release of lung surfactant[11] when lungs have been stretched near to total lung capacity and prostaglandins into alveolar spaces,[12] which increase lung compliance and decreases bronchial smooth muscle tone, respectively. The other possible mechanism for improved pulmonary functions might be: (i) Hypertrophy of respiratory muscles due to regular practice of pranayama; (ii) cleansing procedures cleans the infective nasal secretions; (iii) more efficient use of the diaphragmatic and abdominal muscles thereby emptying and filling the respiratory apparatus more efficiently and completely;[13] and (iv) pranayama has calming effect on the mind which reduces emotional stresses, thereby withdrawing the brancho-constrictor effect. Thus, regular practice of pranayama seems to be beneficial for respiratory efficiency.

Few studies done in the past to show the beneficial effects of yoga on asthmatic patients.[14,15] Furthermore, studies show the effect of yoga on ventilatory responses, respiratory endurance, and muscle strength have been well documented.[16,17] Bera et al. have studied recovery from stress by yogic relaxation posture in their work.[18]

CONCLUSION

From this, it can be hypothesized that regular practice of *Bhastrika pranayama* in older age group helps in keeping lungs more efficient and this can be used as a preventive major to keep the lungs away from respiratory infections and asthmatic attacks in these group of people.

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