

## Effect of Bhastrika Pranayama on respiratory muscle function

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### Abstract

**Introduction:** Respiratory muscles improve their function in response to training. Yogic exercises have the ability to enhance respiratory efficiency. Respiratory training techniques have consistently demonstrated positive outcomes in different respiratory conditions. Aim of the study is to know the effect of Bhastrika pranayama on respiratory muscle function in young adult males.

**Materials and Method:** This study was conducted on 40 healthy adult male aged 18 to 23 years in Government Yoga & Naturopathy Medical College. Peak expiratory flow rate (PEFR), Breath holding time (BHT) and 40 mmHg endurance were measured. Participants practiced Bhastrika pranayama 5 days a week for 45 days, 3 hours after lunch. After 45 days of regular practice, all the above parameters were reassessed.

**Results:** The student paired 't' test was used to compare pre and post training values. Respiratory muscle strength, as indicated by parameters PEFR, BHT and 40 mm Hg endurance test increases significantly after the practice of Bhastrika Pranayama.

**Conclusion:** Bhastrika Pranayama has beneficial effect on respiratory muscle function and is an effective yoga practice for college students.

**Keywords:** Bhastrika Pranayama, Yoga, Peak expiratory flow rate, Breath holding time, 40 mmHg endurance.

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### Introduction

Respiratory muscles are skeletal muscles which have ability to get strengthened and to improve functional outcome in response to exercises like other skeletal muscles.<sup>(1)</sup> Respiratory muscle training helps to enhance cardiorespiratory functions and to increase exercise tolerance.<sup>(2)</sup> Exercise prevents diseases and promotes health.<sup>(3)</sup> Exercise enhances aerobic metabolism and increases vascularization, thus improving the performance of the muscle.<sup>(4)</sup> Yoga is equally effective or even better than exercises in improving the health status of an individual.<sup>(5)</sup> Regular yoga practice considerably decreases oxidative stress and improves the antioxidant levels of the body.<sup>(6)</sup> Yogic exercises have the ability to enhance the respiratory functional status.<sup>(7)</sup> Practice of yogic breathing enhances the respiratory muscle efficiency and lung compliance by reducing the elastic and viscous resistance of lung during inspiration. It also stimulates the pulmonary stretch receptors by inflation of the lung, reflexly relaxes the smooth muscles of the larynx and tracheobronchial tree. Through yogic breathing one learns to consciously alter his or her breathing.<sup>(8)</sup>

'Pranayama' is a Sanskrit word, Prana and Ayama. Prana refers to all forms of energy in the universe. Breathing symbolizes life force, which is a part of Prana. 'Ayama' means development or control. Therefore Pranayama is the development and control of life force.<sup>(9)</sup> Pranayama is considered to regulate breathing. Slow and deep breathing reduces the dead space ventilation, renews air throughout the lungs.<sup>(10)</sup>

Bhastrika pranayama is one of the important type of pranayama. The Sanskrit word "Bhastrika" means "Bellows". Thus, Bhastrika Pranayama is also known as the Bellows breathing, as air is drawn forcefully in and out of the lungs like the bellows of village blacksmith. Bhastrika practice strengthens the diaphragm and abdominal muscles, increases exchange of O<sub>2</sub> and CO<sub>2</sub> in the bloodstream, alleviates inflammation in the throat, reduces accumulation of phlegm and balances and strengthens the nervous system.<sup>(9)</sup>

Peak expiratory flow rate has been used as an index of respiratory muscle function in a study conducted by S.T. Hornby et al.<sup>(11)</sup> BHT & 40 mmHg test has been used as an index of respiratory endurance in a study conducted by Madan Mohan et al in 1992. The study showed significant increase in BHT after a 12 weeks practice of yoga.<sup>(12)</sup> Madanmohan, et al in 2008 have done a study to test the respiratory endurance using 40 mm Hg test in both male and female participants. Yoga training can produce significant improvements in respiratory muscle strength and endurance even when practiced for a short span of 6 weeks.<sup>(13)</sup>

Respiratory muscle weakness is now a days a common problem among patients who have neuromuscular disease. It can be acute, chronic or relapsing. It could cause insufficient ventilation, nocturnal hypoventilation, or ineffective cough.<sup>(14)</sup> Respiratory muscles improve their function in response to training.<sup>(15)</sup> This improved function, in turn, could potentially decrease dyspnoea, improve exercise tolerance. It increases the ability to do daily

activities.<sup>(16)</sup> Training of the expiratory muscles is very important for the production of an effective cough. Respiratory training techniques have consistently demonstrated positive outcomes in different respiratory conditions.<sup>(17)</sup>

This study is therefore designed to analyse the effect of Bhastrika Pranayama on respiratory muscle function and to emphasise the importance of yoga in strengthening respiratory muscles.

### Materials and Method

The study was conducted in Government Yoga & Naturopathy Medical College, Aringar Anna Government Hospital of Indian Medicine & Homeopathy Campus with due permission. After approval from Institutional ethical committee, 40 healthy students of age 18 to 23 years studying in first year were recruited for the study. Students with epilepsy, acute respiratory illness, respiratory disorders, congenital heart diseases, spinal deformities, high blood pressure, hernia, gastric ulcer, stroke and those undergoing any form of yoga or physical training were excluded from the study. Written informed consent was obtained from all participants.

Peak expiratory flow rate, Breath holding time, 40 mmHg endurance time were assessed before pranayama

training. All parameters were measured after the participants were relaxed and three readings were recorded. The maximum reading was noted.

After assessing the parameters, warm up exercises were given for 10 minutes. Bhastrika pranayama training was given for ten days by a yoga trainer. Practice of Bhastrika pranayama was then started for 45 days. It consisted of five rounds of pranayama, 5 days a week following warm up exercises. The whole practice was done in clean, calm and pleasant room inside the college campus at 3.00 pm (3 hours after lunch, as practice should be done on an empty stomach). Practice duration was 30 min each day. After 45 days of regular practice of Bhastrika pranayama, all the above parameters were reassessed.

**Statistical Analysis:** All the values obtained before and after performing 'Bhastrika Pranayama', were expressed as mean  $\pm$  SD. The student paired 't' test was used to compare pre and post training values. P values of less than 0.05 were accepted as significant.

### Results

Results revealed statistically significant change in the respiratory parameters. PEFr, 40mmHg endurance time & BHT were significantly increased after the practice of Bhastrika Pranayama.

**Table 1: Effect of bhastrika pranayama on respiratory parameters in adult males. n = 40**

| S. No | Parameters                               | Pre-test value<br>Mean $\pm$ 1 SD | Post Test Value<br>Mean $\pm$ 1 SD | Mean difference   | 't' value |
|-------|------------------------------------------|-----------------------------------|------------------------------------|-------------------|-----------|
| 1     | Peak expiratory flow rate (litres / min) | 407 $\pm$ 16.52                   | 587.50 $\pm$ 14.46                 | 180.50 $\pm$ 2.48 | 72.80***  |
| 2     | 40mmHg endurance time (sec)              | 26.05 $\pm$ 5.17                  | 69.23 $\pm$ 1.86                   | 43.18 $\pm$ 0.85  | 51***     |
| 3     | Breath holding time (sec)                | 30.93 $\pm$ 3.68                  | 85.23 $\pm$ 3.74                   | 54.3 $\pm$ 0.76   | 1.71***   |

\*\*\* p < 0.0001

### Discussion

This study showed significant improvement in the respiratory muscle function in young adult males following Bhastrika pranayama.

In our study, PEFr showed statistically significant increase from pre test mean value of 407 L/min to post test value of 587.50 L/min. The 'Bhastrika Pranayama' involves using of lung spaces with help of respiratory muscle, which is not used up in normal shallow breathing. Therefore, the increased peak expiratory flow rate might be a consequence of small airway opening in lungs.<sup>(9)</sup> Bhastrika pranayama also improves the capacity of the thoracic compartment by creating negative and positive pressures in the respiratory process and increases the expiratory as well as inspiratory muscle performance.<sup>(18)</sup> There occurs strengthening of respiratory musculature incidental to regular practice of pranayamic breathing during which the lungs and chest gets inflated and deflated to the fullest possible extent thus leading the muscles to work maximally.<sup>(19)</sup>

BHT increased from 30.93 to 85.23 whereas the 40mmHg endurance time increased from 26.05 seconds to 69.23 seconds. Bhastrika practice strengthens the diaphragm and abdominal muscles.<sup>(9)</sup> Either the respiratory centre or some the chemoreceptors (unconfined) shows decreased responsiveness to CO<sub>2</sub> as reported in subjects practicing pranayamic breathing.<sup>(20)</sup> Decreased responsiveness to CO<sub>2</sub> is also reported by deep sea divers and scuba divers, who practice breath holding maneuvers.<sup>(21,22)</sup> An alternate explanation involves that practice of yoga, including pranayama, allows breath holding for a longer duration which produces a wakeful hypometabolic state<sup>(23)</sup> of the body characterized by decreased CO<sub>2</sub> production and decreased O<sub>2</sub> consumption. Regular practice of pranayamic breathing increases the development of respiratory musculature by increasing the muscle endurance and delaying the

onset of their fatigue, thus allowing the breath holding for longer time. Yogic asanas and pranayama increase vital capacity, timed vital capacity, maximum voluntary ventilation, breath holding time and maximal inspiratory and expiratory pressures in adult.<sup>(24)</sup>

## Conclusion

With increased awareness and interest in health and natural remedies, yogic techniques including pranayama are gaining importance and becoming increasingly acceptable to the scientific community. Yogic interventions can be successfully used in improving the health and wellness status of a variety of individuals.

The positive results found in the present study might be applied to all college students to improve the pulmonary functions. Bhastrika Pranayama is an effective tool to improve the respiratory muscle function in young adult males. A few minutes of practice daily may help in setting the mind better on work and studies. The daily practice could also be part of physical fitness and life style modification programs in maintaining better physical and mental health to have a better future.

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