



## STUDY OF EFFECT OF BHASTRIKA PRANAYAMA ON PULMONARY FUNCTION

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### ABSTRACT

Yogic practices can be used as psycho-physiological stimuli to increase in physiological functions and human performance. Yoga breathing or Pranayama is the science of breath control. Rapid succession of forcible expulsion is a characteristic feature of Bhastrika Pranayama. To determine the effects of Bhastrika Pranayama on Vital Capacity of lung (PFT), sixty (n = 60) randomly selected volunteers to participate in the study from OPD of Government Ayurved College, Nanded, Maharashtra. These volunteers were subjected to the 12 week Pranayama training programme that includes "Bhastrika Pranayama". The before after differences were assessed using the Student's t-test for dependent data. The level of  $p < 0.05$  was considered significant. The Pulmonary function significantly improved after 12 weeks of study comparing with base line values. Pranayama exercises are beneficial for the better maintenance of Pranavaha strotasa functions, particularly pulmonary functions, even in normal healthy.

**Key Words:** Pranayama, Bhastrika, Pulmonary function, Yoga.

### INTRODUCTION

Pranayama is an important, yet little part of yoga. Its techniques have been practiced for centuries. The physiological and psychological benefits of yoga have been demonstrated in several studies.<sup>1-4</sup> These studies have shown that regular practice of yoga leads to improvement in physiological functions and human performance.

Yogic practices can be used as psycho-physiological stimuli to increase endogenous secretion of melatonin, which in turn, might be responsible for improved sense of well-being.<sup>5</sup> Training to yoga respiration selectively increases the respiratory sensation, perhaps through its persistent conditioning of the breathing pattern.<sup>6</sup> Perhaps one of the most powerful tools in yogic practices is the use of the breath to bring our consciousness back in tune with the Divine Cosmic Breath. This cosmic breath is the rhythm of life itself. Yoga breathing, or Pranayama, is the science of breath control. Pranayama (breathing exercise), one of the yogic techniques can produce different physiological responses in healthy individuals.<sup>7</sup> The science of pranayama is based on the retention of prana called 'kumbhaka'. Among the many kinds of pranayama, anulom vilom and bhastrika are considered as one of the significant types of the core structuration of pranayama.

Bhastrika pranayama is mainly a combination of Kapalbhata and Ujjayee. Rapid succession of forcible expulsion is a characteristic feature of Bhastrika pranayama, whereas anulom vilom pranayama is also called "Nadishuddhi Pranayama", in this breathing technique you inhale from one nostril at one time and release the breath through the other nostril.<sup>8</sup> There have been many studies on yoga and its effects on physical function but with the phenomenal and ever increasing popularity of Pranayama in the past few years, there is a lack of study on this particular discipline and as a result the present study has been undertaken to examine the effects of bhastrika pranayama on the Pulmonary function.

### Objectives

To evaluate changes in pulmonary functions after performing Bhastrika Pranayama for limited period.

### MATERIAL & METHODS

#### Sample Size Calculation

Sample size calculation was based on the assumption that a sample size of 60 cases would provide a 90% power to detect mean change in frequency of growth per fortnight at 5% level of significance.

#### Institutional Ethics Committee Approval and Regulatory Compliance

Before the initiation of the study, the study protocol and related documents were reviewed and approved by Institutional Ethics Committee at Govt. Ayurved College & Govt. Ayurved hospital, Nanded, Maharashtra. The study was conducted in accordance with Schedule Y of Drugs and Cosmetics act, India, amended in 2005 and ICMR ethical guidelines for biomedical research on human participants 2006.

#### Patients Screening and Recruitment

The present study included, of either sex having healthy respiratory system. The study was conducted in the Department of Swasthavritta, Government Ayurved College & Hospital, Nanded, Maharashtra. The volunteers were recruited from our hospital.

#### Inclusion Criteria

1. Having age group 20-50 years.
2. Of both sexes.
3. Having normal physiological functions of respiratory system were selected.
4. Who were able to perform Pranayama daily for an hour were recruited.

#### Exclusion Criteria

1. Having age less than 20 years or more than 50 years
2. Pregnant women
3. Habits of tobacco chewing, smoking and alcoholic were avoided.
4. Having diseases of Respiratory tract e.g. history of tuberculosis, chronic obstructive airway disease (COPD), respiratory tract infections within the previous 6 weeks.
5. Performing Pranayama less than 5 days a week also not included in this study.
6. having diabetes, renal failure, coronary artery disease and

musculoskeletal chest deformities

7. Engagement in any regular exercise/training

#### Instruments

For examination following instruments were used -

1. Thermometer
2. Weighing machine
3. Stopwatch
4. BP apparatus
5. Stethoscope
6. Measuring tape
7. Breeze suite spirometer 6.3 (For FVC, FEV<sub>1</sub>, PEFR, SVC, MVV)
8. Haemometer

#### Study Procedure

60 volunteers were randomly selected and all were considered as experimental group. Each volunteer was first explained the complete Pranayama procedure which is explained in text 'Hathayogpradipika' and was demonstrated the same.

Yogic exercises used by the included pranayamas (deep breathing exercises). Each yoga training session was of 60 minutes duration per day with a trained instructor for a period of 12 weeks. Volunteer were instructed to practice at home, 60 minutes daily on all days of the week. The subjects also maintained a diary record of each day of the yoga practice.

#### Method of Pranayama

##### Suryabhedana

First all volunteers (volunteers) were requested to sit in Padmasana or Sukhasana. They were asked to close their eyes, then inhale air through right nostril up to Udarpuran, hold the air as long as possible then slowly exhale air through left nostril. This procedure was performed for 7 minutes.

##### Ujjayi

First all volunteers were requested to sit in Padmasana or Sukhasana. They were asked to close their eyes and mouth, then having closed the opening of Nadi (larynx), the air should be drawn in such a way that it goes touching from the throat to the chest and making noise while passing. Then put a Jalandhar Bandha and hold as long as possible, close the right nostril gently with thumb and exhale air through left nostril. This procedure was performed for 7 minutes.

##### Sitkari

Sitkari was performed by drawing in the air through the mouth, while keeping the tongue between the lips. The air thus drawn in should not be expelled through the mouth, then slowly exhale through both nostrils. This procedure was performed for 7 minutes.

##### Shitali

Volunteers were requested to do the above procedure as in (Sitkari), the tongue to be protruded a little out of the lips, when the air was drawn in, it was kept confined as before and then expelled slowly through the nostrils. This procedure was performed for 7 minutes.

##### Bhastrika

All volunteers were requested to sit in Padmasana or Sukhasana, in such a way that head, neck and vertebral column would be in straight line. Then ask them to inhale and exhale through both nostrils as fast as they can, just as a pair of bellows of the blacksmith was worked. This procedure would be performed for 20 to 30 times, then ask them to take long inhalation and long exhalation thus the first chakra would be completed. Ask them to complete such three chakras. This procedure was performed for 15 minutes.

##### Bhramari

All volunteers were requested to sit in Padmasana or

Sukhasana. All volunteers were requested to fill air with force, making noise like Bhrngi (wasp) and expelling it slowly, making noise in the same way. This procedure was performed for 7 minutes.

##### Murccha

First all volunteers were requested to sit in Padmasana or Sukhasana. They were requested to close their eyes, then ask them to close the right nostril gently with thumb, inhale through the left nostril, put a Jalandhar Bandha and hold the air as long as possible, then slowly exhale air through both nostrils. This procedure was performed for 5 minutes.

##### Plavini

All volunteers were requested to sit in Padmasana or Sukhasana. They were requested to close their eyes, ask them to inhale air through both the nostrils up to Udarpuran. Then ask them to hold the air as long as possible or put an Uddiyan Bandha and then slowly exhale air through both nostrils. This procedure was performed for 5 minutes.

All were examined by Ayurvedic and Modern parameters on day 1<sup>st</sup>. Then daily early in the morning in between 6.00 am to 7.00 am. Pranayama was performed. After 4<sup>th</sup> & 8<sup>th</sup> weeks of Pranayama practice above all were again examined by Ayurvedic and Modern parameters. Case Record form was prepared for observations of at specific interval. (Day 1, after 4<sup>th</sup>, 8<sup>th</sup> & 12<sup>th</sup> weeks). Same procedure had been done after 12 weeks.

Pulmonary function tests (PFT) were recorded by Breeze suite 6.3 a computerized spirometer. The parameters of PFT included in the study were FVC (forced vital capacity), FEV<sub>1</sub> (forced expiratory volume in one second), PEFR (Peak expiratory flow rate), SVC (slow vital capacity), MVV (Maximum volume ventilation). Recordings were done on day first, after 6 weeks and after 12 weeks of Pranayama practice.

Day first means the very first day the subjects started Pranayama practice. For PFT, the subjects were first explained the whole procedure and were demonstrated the same. The subjects performed the test in sitting position. Day first readings were considered self as control and data analyzed by paired 't' test.

#### Statistical Analysis

Students paired 't' test was applied to determine the significance. The level of significance was set at 5%,  $P < 0.05$ ,  $t_{\text{calculated}} > t_{\text{table}}$  value indicates the significance and it reveals the effect was not usual but it was due to Pranayama

#### RESULTS

Of the 82 screened, 22 did not meet the inclusion criteria and hence were not included in the trial. Of 60 included in the trial, 36 were male while 24 were female. Sixty completed the study. No volunteer was dropped out or withdrawn due to the adverse event or an adverse reaction. Bhastrika Pranayama did cause any significant change in vital signs like pulse rate, respiratory rate, and the blood pressure & PFT (Pulmonary function test).

Mean FVC at baseline of study was  $3.03 \pm 0.64$  and was increased significantly to  $3.8 \pm 0.69$  (at 12<sup>th</sup> wk). The mean FEV<sub>1</sub> at baseline of study was  $2.74 \pm 0.5$  and it was increased significantly to  $3.00 \pm 0.5$  (8<sup>th</sup> week) and  $3.16 \pm 0.52$  (12<sup>th</sup> week). The mean PFER at baseline of study was  $347.96 \pm 124.16$  and was shown significant growth  $375.23 \pm 122.12$  at end of 12<sup>th</sup> week. SVC of these Volunteers shows significant growth from  $3.64 \pm 1.12$  to  $4.10 \pm 1.2$  at the end of 12<sup>th</sup> week. Also MVV of these volunteers was increased from  $105.23 \pm 17.07$  to  $123.01 \pm 25.37$  at end of 12<sup>th</sup> week. At baseline,

mean score of pulse rate was  $79.21 \pm 6.14$  and it was decreased slightly to  $74.78 \pm 5.54$ . Respiratory rate of these volunteers at baseline was  $20.23 \pm 1.71$  and in was decreased slightly to  $16.70 \pm 1.52$ . Shwasa Nigrahana Kala was

increased from  $25.43 \pm 8.05$  to  $29.75 \pm 8.18$ . Mean weight of volunteers was also decreased slightly from  $60.05 \pm 8.7$  to  $58.8 \pm 8.24$  [Table 1, 2]

Pulmonary Function Tests					
Interval	FVC (Lit)	FEV <sub>1</sub> (Lit)	PFER (Lit/sec)	SVC (Lit)	MVV (Lit/min)
Day 1	$3.03 \pm 0.64$	$2.74 \pm 0.5$	$347.96 \pm 124.16$	$3.64 \pm 1.12$	$105.23 \pm 17.07$
After 4 Wks	$3.33 \pm 0.68$	$2.88 \pm 0.5$	$353.05 \pm 122.87$	$3.74 \pm 1.09$	$110.88 \pm 20.18$
After 8 Wks	$3.54 \pm 0.7$	$3.00 \pm 0.5$	$361.33 \pm 121.83$	$3.9 \pm 1.09$	$117.25 \pm 22.74$
After 12 Wks	$3.8 \pm 0.69$	$3.16 \pm 0.52$	$375.23 \pm 122.12$	$4.10 \pm 1.2$	$123.01 \pm 25.37$

Interval	Pulse rate (per min)	Respiratory rate (Per min.)	Shwas Nigraha Kala (Per min.)	Weight (Kg)
Day 1	$79.21 \pm 6.14$	$20.23 \pm 1.71$	$25.43 \pm 8.05$	$60.05 \pm 8.7$
After 4 Wks	$77.76 \pm 5.65$	$19.11 \pm 1.78$	$26.75 \pm 8.05$	$59.6 \pm 8.3$
After 8 Wks	$76.47 \pm 5.84$	$17.98 \pm 2.02$	$28.19 \pm 8.1$	$59.09 \pm 8.27$
After 12 Wks	$74.78 \pm 5.54$	$16.70 \pm 1.52$	$29.75 \pm 8.18$	$58.8 \pm 8.24$

## DISCUSSION

Out of 60, 41 i.e. (68.33%) were found decrease in weight, 11 i.e. (18.33%) were found increase in weight and 8 (i.e. 13.33%) were found constant weight. 42 of 60 i.e. (70.00%) were found decrease in pulse rate, 4 (i.e. 6.66%) were found increase in pulse rate and 14 (i.e. 23.33%) were found constant pulse rate. 48 of 60 (i.e. 80.00%) were found decrease in respiration rate, 4 (i.e. 6.66%) were found increase in respiration rate and 8 were found constant respiration rate. The increase in metabolism could be due to increased sympathetic discharge to the adrenal medulla. Breathing through a particular nostril could selectively activate either division of the autonomic nervous system. We can speculate that right nostril breathing increases metabolism perhaps by increasing the output of adrenaline from the adrenal medulla while sympathetic output to the sweat glands does not change. In contrast left nostril breathing produced a marked decrease in sympathetic activity to the sweat glands whereas other subdivisions did not change as much. The exact mechanism by which nostril breathing influences the function of the autonomic nervous system is not known, though it has been speculated that this is through a neural reflex mechanism in superior nasal meatus. Pranayama effect on skeletal muscular relaxation or activity, on variations of autonomic nervous system discharges altering regional blood flows and metabolism, and even on adrenal cortico-medullary secretions. The present study has demonstrated a significant (paired 't' test) increase in Hb%. Pranavayu along with raktadhatu provides nutrition to all over body therefore raktadhatu must be strong. Origin of lungs is from froth of the raktadhatu, so strength of lungs depends on raktadhatu. Pranayama increases raktadhatvagni, Pranayama helps for formation of good quality raktadhatu. Thus along with raktadhatu Pranayama acts on pranavahasrotasa, it implies increase in functions of rakta dhatu i.e. Jeevan karma is due to Pranayama. The study also illustrates a significant increase in Shwasa nigrahana kala. Shwasa nigrahana kala is function of pranavayu. Shwasa nigrahana kala is the important examination of pranavaha

srotasa. Due to the Pranayama there is increase in shwasa nigrahanakala. It implies that Pranayama definitely acts on pranavayu.

The present study has demonstrated a significant increase in Numerical test. Numerical test depends up on udanvayu. It implies that Pranayama definitely acts on udanvayu.

The present study has confirmed a significant increase in FVC and FEV<sub>1</sub>. The improvement in vital capacity is due in part to increased development of respiratory musculature incidental to regular practice of Pranayama. By the practice the respiratory apparatus is emptied and filled more completely and efficiently which is recorded in terms of increased FVC. The increase in FEV<sub>1</sub> might be due to significant increase in vital capacity.

The study also implies a significant increase in SVC. Lung inflation near to total lung capacity is a major physiological stimulus for the release of lung surfactant and prostaglandins into alveolar spaces which increase compliance and decrease bronchial smooth muscle tone, respectively.

Significant increase in PEF and MVV may be due to Pranayamic breathing exercises practitioners to use the diaphragmatic and abdominal muscles more efficiently thereby emptying and filling the respiratory apparatus more efficiently and completely.

Pranayama, with its calming effect on the mind can reduce and release emotional stresses thereby withdrawing the broncho-constrictor effect. It is suggested that the Ashta kumbhaka Pranayama was beneficial for chosen ; further study on larger population and the longer period of follow up is necessary to get desired results as well as to differentiate each Pranayama from one another by their peculiar functions.

## CONCLUSION

Inspiration is a main process in Pranavaha Strotasa which is due to Pranavayu. Significant increase in PFT i.e. FVC, FEV<sub>1</sub>, SVC, PFER & MVV (by paired 't' test) was found in . It implies that increase in PFT (pulmonary function test) is due to Bhastrika pranayama. Shwasa nigrahana is main function of Pranavayu. Significant increase in Shwasa nigrahana kala was found after Bhastrika pranayamic

procedures. Lung vital capacity was found increased after bhastrika Pranayama; it implies increase in physiological strength of lungs. It can be stated that Pranayamic exercises are beneficial for the better maintenance of Pranavaha strotasa functions, particularly pulmonary functions, even in normal healthy.

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