

# Respiratory endurance in asymptomatic smokers

Pragyashaa Chaudhary<sup>1</sup> Vinita Ailani<sup>2</sup> Nimarpreet Kaur<sup>3</sup>

<sup>1</sup>Tutor FMHS, SGT University (Research Scholar NIMS University, Jaipur)

<sup>2</sup>Professor, Department of Physiology, National Institute of Medical Sciences & Research, Jaipur

<sup>3</sup>Professor, Department of Physiology, (FMHS, SGT University), Gurgaon

Corresponding author: Pragyashaa Chaudhary [pragyashaa@gmail.com](mailto:pragyashaa@gmail.com)

KEYWORDS

ABSTRACT

Asymptomatic smokers, Pranayam, BHTi, BHTe, 40mmHg, respiratory endurance.

**Introduction:** Cigarette smoking is a significant health hazard and remains the leading cause of preventable deaths worldwide. The consistent practice of Pranayama and Om chanting has been shown to influence various body systems, particularly the respiratory system. This study aims to explore the impact of traditional techniques such as Alternate Nostril Breathing (ANB) and Om chanting on respiratory endurance in symptomatic smokers. **Aim:** To evaluate the effectiveness of pranayam and Om chanting on respiratory endurance. **Materials and Methods:** An interventional study was carried out in the Department of Physiology at the Faculty of Medicine and Health Sciences, SGT University, Gurugram, Haryana, India. The study spanned eight weeks and involved 100 participants, both male and female, aged 18 to 25 years, all asymptomatic smokers. Baseline measurements of anthropometric parameters and respiratory endurance parameters, including BHTi, BHTe, and the 40 mmHg test, were recorded at the beginning of the study and again after the eight-week intervention. Respiratory endurance was compared using the paired t-test. **Results:** Comparison of parameters of respiratory (BHTi, BHTe, and 40mmHg) were also found to be statistically significant (p-value < 0.001\*). **Conclusion:** After the 8-week intervention, there was a significant improvement in all the measured parameters. Both Alternate Nostril Breathing (ANB) and Om chanting, as forms of yogic breathing, can serve as complementary alternative therapies alongside medication for individuals with chronic obstructive lung diseases.

## INTRODUCTION

Smoking cigarettes is responsible for one of the major health threats and also the leading cause of preventable death.<sup>(1,2)</sup> It is known that there are thousands of noxious components that come from cigarette smoke including acrolein, formaldehyde, carbon monoxide, nicotine, cotinine; acetaldehyde, phenol and potassium cyanide (Environmental Protection Agency, 1993).<sup>(2)</sup> The acidic pH of cigarette smoke (5.3) causes significant ionization of nicotine, allowing a substantial amount to be absorbed into the lungs.<sup>(3)</sup> The respiratory system is the first to be affected by cigarette smoke.<sup>(1,3)</sup> The respiratory illnesses triggered/initiated by smoking are bronchitis, emphysema, chronic obstructive pulmonary disease (COPD), and bronchogenic cancer. The major effects produced in the respiratory system are due to Cigarette smoke which contains substances such as nicotine and carbon monoxide. Cigarette smoking causes an increase in inflammatory cells in the lungs, which releases free radicals, and severely damages the function of the narrow airways.<sup>(3)</sup> Smokers can develop conditions that do not align with the traditional definition of COPD involving airflow

obstruction as detected by spirometry. For instance, they may experience chronic bronchitis, persistent cough or phlegm, or develop non-obstructive chronic bronchitis without airflow obstruction.<sup>(4)</sup> Smokers exhibit reduced lung function compared to non-smokers. Smoking is the leading risk factor for the development of COPD.<sup>(1)</sup> Smoking also reduces the respiratory muscles functioning due to influence of free radicals on the vascular system. Which is also reflected in the lung function parameters.<sup>(5)</sup>

Yogic breathing, also known as PRANAYAM, is the most ancient basis of yoga practice, which involves a conscious, controlled & regulated breathing exercise that has been said to produce significant physiological changes in an individual.<sup>(6)</sup> There are various forms of pranayama including nostril breathing (double, single, or alternate), abdominal breathing, forceful breathing and vocalized (chanting) breathing, which are performed at different rates and depths.<sup>(7)</sup> Alternate nostril breathing (ANB) is considered one of the best forms of breathing exercises, as it promotes sympatho-vagal balance, which improves autonomic functions. Yogic breathing has been shown to effectively decrease oxidative stress. Moreover, it has been found that it reduces the quantity of free radicals and enhances the activity of superoxide dismutase (SOD) in healthy individuals.<sup>(8)</sup> As we know Pranayama consists of controlled breathing exercises that involve breath-holding, leading to isometric contraction of the respiratory muscles. Additionally, certain types of Pranayama involve forceful breathing. Both practices can help strengthen the respiratory muscles, thereby improving respiratory endurance.<sup>(9)</sup> It is reported that cigarette smokers experience a rapid annual decline in FEV1 of approximately 50 ml, nearly twice the average annual decline of 30 ml observed in non-smokers. In our study we wanted to explore if this reported decline can be prevented by this simple intervention.<sup>(12)</sup> Respiratory pressures, breath holding time, and 40 mmHg test are simple, non-invasive, and easily reproducible tests without any complications that can be used to test respiratory endurance. Hence, we used these tests in the present study to find out whether Pranayama improves respiratory endurance in young adults. The results of this study would help to emphasize the role of Pranayama in improving respiratory endurance and the importance of regular Pranayama practice as a modification to prevent deterioration of lung function in smokers.

## **MATERIALS AND METHODS**

The study group consisted of 100 young adults aged 18 to 25 years, all asymptomatic smokers, recruited from the staff and students of SGT Medical College, Gurgaon. The research was conducted in the Department of Physiology at SGT Medical College, following approval from the Institutional Ethics Committee. Participants were selected based on the following inclusion and exclusion criteria. The inclusion criteria encompassed asymptomatic tobacco smokers of both genders, aged 18 to 25 years, with a smoking history that met the definition of a current smoker: an adult who has smoked at least 100 cigarettes in their lifetime and currently smokes cigarettes daily, as per the National Centre for Health Statistics and the Global Adult Tobacco Survey India Report 2016-2017. The exclusion criteria ruled out individuals with a medical history of systemic disorders, particularly respiratory tract conditions, allergies, or consistent medication for any illness. Subjects with chest and spine deformities such as kyphosis and scoliosis, pregnant, postpartum, or lactating females, and individuals engaged in pranayama, yoga, exercise, or meditation before recruitment were also excluded.

After taking informed consent, anthropometric parameters like age, height, and weight were recorded, and the baseline data for respiratory endurance parameters including:

- Breath holding time after inspiration (BHTi)
- Breath holding time after expiration (BHTe),
- 40mmHg endurance test

were collected before introducing the intervention.

**Interventions:** Subjects practiced the combination of Alternate nostril breathing and Om chanting before the lunch break around 12:15- 12:45 pm under supervision for 10 minutes (5mins for each protocol as given below) for the period of 6 days/week for 8 weeks.)

**Om Chanting:** Participants were instructed to get into the sukhasana posture and take a deep breath. They were then urged to exhale while producing the sound "OM" and continue doing so until they were unable to exhale any further.

**For ANB:** subjects were instructed to close the right nostril with their right thumb and bring right elbow to the level of the right shoulder, inhale and exhale through left nostril first slowly and repeat the procedure through the other nostril.

**Breathe holding time (BHT):**

When in the sitting position, the subjects were instructed to hold their breath. The patient was instructed to hold their breath until they could no longer do so voluntarily, and the duration was recorded using a timer. BHT was noted at the end of inspiration (BHTi) and at the end of expiration (BHTe)

**Respiratory endurance test (40mm Hg test):**

This test utilized a mercury sphygmomanometer. The rubber tubing connecting the mercury reservoir to the BP cuff was detached. The participant was directed to inhale deeply and then close their nostrils, exhaling into the tube until the mercury reached a level of 40mm. They were then advised to maintain this level for as long as they could. The time was recorded using a stopwatch.

**Data analysis:**

The data was analyzed by statistical analysis of baseline and post-intervention assessments of the total subjects (n = 100), by using student t-test. Pre and post-assessment were analyzed using paired t-tests. P < 0.05 was considered as significant.

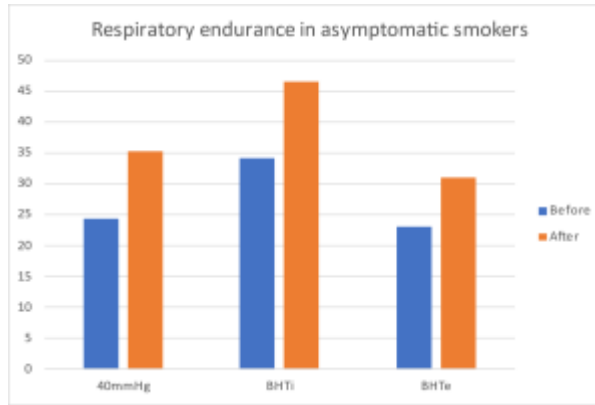
**RESULT**

A total of 100 subjects asymptomatic smokers were recruited (Mean SD age, BMI) for the study, and complete assessment pre- and post-intervention was done for 100 subjects. There was a significant increase in all the parameters observed BHT (inspiration & expiration) and 40mmHg test of respiratory endurance and the increase was statistically significant.

*Table 1: Respiratory endurance in asymptomatic smokers*

| <b>Variables</b> | <b>Before</b> | <b>After</b> | <b>P value</b> |
|------------------|---------------|--------------|----------------|
| <b>40mmHg</b>    | 24.43         | 35.33        | 0.00001*       |
| <b>BHTi</b>      | 34.06         | 46.45        | 0.00001*       |
| <b>BHTe</b>      | 23.12         | 31           | 0.00001*       |

*Bar Diagram 2: Respiratory endurance in asymptomatic smokers*



## DISCUSSION

Our study's results showed a significant increase in the parameters of respiratory endurance, namely BHTi, BHTe, and 40 mmHg. These findings coincide with various studies performed previously. BHTe and BHTi both increased significantly ( $P < 0.001$ ) after the training program. BHTi increased more as compared to BHTe. BHT depends on the initial lung volume, training, and will power of the subject. Our findings are similar to various studies done in the past. Bagade et al. did research on healthy adults, those who were non-smokers and found a significant improvement in the parameters of respiratory endurance, with greater improvement in BHTi as compared to BHTe and 40mmHg test which coincides with the results of our study.<sup>(9)</sup>

It has been reported that pranayam improves overall performance and it significantly improves respiratory functions, reduces respiratory rate, and improves working capacity. Additionally, they enhance vital capacity, timed vital capacity, maximal voluntary ventilation, breath-holding time, maximal inspiratory pressure, and maximal expiratory pressure.<sup>(10)</sup> Deep breathing exercises are not only effective in improving lung function but also in preventing the development of chronic obstructive pulmonary complications in healthy smokers. Practices like Yoga (Pranayama) are also beneficial for maintaining respiratory health.<sup>(11)</sup>

The aim was to determine whether regular practice of Pranayama enhances respiratory endurance and to what extent. Simple, non-invasive, and easily reproducible tests such as respiratory pressures, breath-holding time, and the 40 mmHg test, which have no associated complications, were used to evaluate respiratory endurance. These tests were employed in the current study to assess the impact of Pranayama and Om chanting on respiratory endurance in young asymptomatic smokers. The findings of this study would highlight the benefits of Pranayama in improving respiratory endurance and underscore the importance of consistent practice.

Lata M et.al did research to understand the impact of pranayama on young and middle-aged healthy populations and found a significant improvement on the parameters of respiratory endurance along with an increase in spirometric parameters after the practice of pranayama which aligns with the result of our research.<sup>(10)</sup>

Choudhary et.al, conducted on 100 healthy students and volunteers between the ages of 17-26 years including both males and females and the subjects were non-smokers after practicing pranayama and asanas for three months there was a significant change in the breath-holding time. These findings are also similar to the result of our study.<sup>(13)</sup> Murugesan et.al did research on 45 subjects aged between 18-45 years of age and pranayama was performed for 12 weeks. At the end of the intervention, it was seen that the respiratory muscles and respiratory endurance had significantly improved after the practices, which led to significant improvement in 40mmHg and BHT. Our study also had similar findings but in asymptomatic smokers.<sup>(14)</sup>

As observed by Joshi et al., this increase can be attributed to reduced CO<sub>2</sub> sensitivity in individuals practicing Pranayamic breathing. A similar effect is seen in deep-sea and scuba divers who regularly practice breath-holding. This improvement is likely due to greater strength and endurance in their respiratory muscles, which delays fatigue and enables longer breath-holding duration.<sup>(15)</sup> 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. Breath-holding time (BHT) is influenced by factors such as initial lung volume, training, and willpower. A larger lung volume reduces the frequency and intensity of involuntary respiratory muscle contractions, thereby minimizing discomfort during breath-holding. As a result, it is easier to hold one's breath at near-total lung capacity compared to near-residual volume. During yoga practice, individuals consciously and repeatedly suppress the stimuli to respiratory centers, gaining a degree of control over respiration. This, along with improved cardiorespiratory endurance, may contribute to the extension of BHT in individuals trained in yoga. Additionally, yoga practice may alter the sensitivity of medullary and systemic arterial chemoreceptors, further prolonging BHT.<sup>(6)</sup>

The notable improvement in respiratory endurance and pulmonary function can be linked to decreased sympathetic activity resulting from the practice of Alternate Nostril Breathing (ANB) and Om chanting. Consistent practice likely supports bronchodilation, optimizes breathing patterns, and lowers the tone of respiratory muscles. This enables more effective use of the bronchioles, enhances airflow and blood perfusion, and leads to better pulmonary function and increased respiratory endurance in asymptomatic smokers as well as in healthy individuals.<sup>(16)</sup>

## CONCLUSION

Pranayama is an ancient yogic practice that harmonizes the mind and body through regular practice. Unlike other forms of exercise, it primarily emphasizes awareness of bodily sensations. By directly influencing various bodily functions, Pranayama provides numerous positive benefits. Our study demonstrated significant improvements in pulmonary function test values after just six weeks of Pranayama practice. The possible reasons for this improvement include the following:

- 1) Pranayama practice enhances expiratory power and reduces airway resistance in the lungs.
- 2) The increase in voluntary breath-holding time may result from the chemoreceptors adapting to hypercapnia. Consistent practice of slow, deep, and forceful inspiration and expiration over an extended period during Pranayama strengthens the respiratory muscles.

## REFERENCES

- 1) Sophie K, Singh N, Dharvey AJ. Study of pulmonary function test in asymptomatic smokers and non-smokers between 30-50 years of age in a tertiary care hospital. *International Journal of Advances in Medicine*. 2017 Jul 20;4(4):959.
- 2) Thenmozhi P, Bhuvaneshwaran D. Suryanadi Pranayama on Physiological Indices among Smokers. *International Journal of Research in Pharmaceutical Sciences*. 2021 Jan 6;11(SPL4):841-7.

- 3) Malge M, Surendra BV. A Comparative Study of Pulmonary Function Tests among Smokers and Non-Smokers in a Tertiary Care Hospital. *International Journal of Pharmaceutical and Clinical Research* 2023; 15(2); 431-434.
- 4) Hernández-Zenteno R, Flores-Trujillo F, Jesús Javier Vázquez-Cortés. Symptomatic and Asymptomatic Smokers without Airflow Obstruction: A New Clinical Entity? the official journal of the mexican national institutes of health. 2019 Feb 4; 71:64-9.
- 5) Tantisuwat A, Thaveeratitham P. Effects of Smoking on Chest Expansion, Lung Function, and Respiratory Muscle Strength of Youths. *Journal of Physical Therapy Science*. 2014 Feb 28;26(2):167–70.
- 6) Madanmohan N, Thombre DP, Balakumar B. Effect of yoga training on reaction time, respiratory endurance and muscle strength. *Indian Journal of Physiology and Pharmacology*. 1992 Oct 1;36(4):229–33.
- 7) Mooventhan A, Khode V. Effect of Bhramari pranayama and OM chanting on pulmonary function in healthy individuals: A prospective randomized control trial. *International Journal of Yoga*. 2014;7(2):104.
- 8) Bhattacharya S, Pandey US, Verma NS. Improvement in oxidative status with yogic breathing in young healthy males. *Indian J Physiol Pharmacol*. 2002 Jul; 46(3):349-54.
- 9) Bagade A, Bhonde M, Dhokane N. Effect of Pranayama on respiratory endurance in young adults. *National Journal of Physiology, Pharmacy and Pharmacology*. 2018 ;8(9):1175.
- 10) Mullur LM, Bagali SC, Khodnapur JP, Aithala MR. Role of short term yoga on pulmonary functions of young and middle aged healthy individuals. *International Journal of Biomedical and Advance Research*. 2012 Apr 30;3(4).
- 11) Rupareliya VP, Chauhan P, Gohil N. Immediate effects of slow pranayama on cardio respiratory parameters in young adult tobacco smokers": Experimental study. *International Journal of Research and Analytical Reviews [Internet]*. 2022 Sep 15;9(3):671–80.
- 12) Dutt S, Gogia T, Gupta M. A comparative study on pulmonary function tests in smokers & nonsmokers. *Indian Journal of Clinical Anatomy and Physiology*. 2021 Apr 15;8(1):53–6.
- 13) Choudhary DS. Effects Of Yogic Asanas, Pranayam & Relaxation Techniques On Ventilatory Functions, Respiratory Pressures, Breath Holding Time And Respiratory Endurance. *GJRA - Global Journal For Research Analysis*. 2023;Volume 12 Issue 4(12).
- 14) Murugesan R. Physical Education Influence Of Pranayama Practices On Respiratory Endurance Among College Men Students. *Star International Journal*. 2017;5(11).
- 15) Joshi LN, Joshi VD, Gokhale LV. Effect of short term Pranayam practice on breathing rate and ventilatory functions of lung. *Indian J Physiol Phannacol* 1992; 36(2) : 105-108
- 16) Yadav A, Singh S, Singh KP. Role of Pranayam breathing exercise in rehabilitation of coronary artery disease patients- A pilot study. *Indian J Traditional Knowledge*. Vol 8(3), July 2009, 455-458.