Original Article

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Physiology Section

Effect of Pranayama and Suryanamaskar on Pulmonary Functions in Medical Students

P. SHYAM KARTHIK[1], M.CHANDRASEKHAR[2], KONDAM AMBAREESHA[3], C.NIKHIL[4]

ABSTRACT

Background: Pranayama improved lung functions in numerous studies. Yoga involve isometric contraction and improves skeletal muscle strength. Yoga training improves the strength of expiratory as well as inspiratory muscles.

Aim: The present study is planned to find the effect of pranayama on pulmonary functions in medical students.

Materials and Methods: This study is conducted on 50 students doing I[st] year M.B.B.S. Consent form has been taken from them. They have been given yoga training 30 min daily for 2 mnth under the guidance of a trained yoga instructor. Vital capacity (VC), Tidal volume (TV), Expiratory Reserve volume (ERV), Breath holding time (BHT), 40 mm endurance, Peak expiratory flow rate (PEFR) are measured before & after yoga training.

Results: VC has increased from 2972 ± 213.151 to 3372 ± 528.7722. TV has increased from 496 ± 84.06347 to 588 ± 150.8863. ERV also shows increase in values from 888 ± 183.303 to 1096 ± 386.7385. BHT also shows increase in values from 33 ± 5.773503 to 58.6 ± 12.78019. 40 mm endurance also shows increase in values from 30.8 ± 5.139715 to 53.52 ± 15.68736. PEFR also shows increase in value from 388.8 ± 15.36229 to 425.2 ± 38.74274.

Conclusion: There is a statistically significant increase in all the above mentioned pulmonary functions following yoga training. Yoga practice can be advocated to improve pulmonary functions in healthy individuals and hence to prevent respiratory diseases in future.

Keywords: BHT, ERV, PEFR, Pranayama, Pulmonary functions, Surya namaskar, TV, 40mm endurance, VC

INTRODUCTION

The word yoga means 'union': union of mind, body and spirit - the union between us and the intelligent cosmic spirit of creation- 'the oneness of all things' [1]. So pranayama—literally, "control of prana"—isn't just breathing exercises. Through pranayama, you use the breath to affect the constellation of energy that is your body-mind [2].

Prana - "life force" or "life energy"

Yama - "discipline" or "control"

Ayama - "expansion", "non-restraint", or "extension

The five principles of yoga are relaxation, exercise (asanas), pranayama (breathing control), nourishing diet, and positive thinking and meditation, pranayama are yogic breathing techniques that increase the capacity of lungs. Pranayama which is control of inspiration and expiration [3]. The inspiration of prana-vayu is shwasa and expiration is prashwasa and cessation of both is characteristic of pranayama.

Pranayama improves overall performance of the body. The regular practice of pranayama increases chest wall expansion and almost all lung functions. The beneficial effect of different pranayama is well reported and has sound scientific basis [3-4]. Pranayama makes efficient use of abdominal and diaphragmatic muscles and improves the respiratory apparatus [5]. Yoga strengthens the respiratory musculature due to which chest and lungs inflate and deflate to fullest possible extent and muscles are made to work to maximal extent [6-7].

AIM AND OBJECTIVES

Effect of pranayama on pulmonary functions in adults has already been studied by various researchers. This study is done to find out the significant increase in respiratory functions in medical students under pranayama training. The primary purpose of this exploratory analysis is to study the importance of pranayama & surya namaskar on pulmonary functions.

MATERIALS AND METHODS

Fifty medical students under the age 17-19 y from Meenakshi medical college, Kanchipuram were involved in this study under voluntary basis. The study was performed after obtaining approval from the institutional ethical committee and informed consent from all the subjects. Students who had already undergone yoga training, smokers and alcoholics, students with any disorders, students who had undergone any surgery are abstained from this study. This study was conducted in the Department of Physiology. They were given yoga practice for two months. They were instructed to do yoga for 30 min daily under the guidance of a trained yoga instructor. Parameters such as Vital Capacity (VC), Tidal Volume (TV), Expiratory Reserve Volume (ERV), Breath Holding Time (BHT), 40 mm endurance, Peak Expiratory Flow Rate (PEFR) were assessed before and after two months of yoga training. The parameters were measured using Spirometer and Wright's expiratory flow meter. The results were compared using student's paired t test. SPSS software is used for all statistical analysis.

The following yoga practices were given to the subjects daily for two months:

Nadisuddi: Close the right nostril with the right thumb. Now inhale slowly through the left nostril and fill your lungs. After inhalation, close the left nostril with ring finger of right hand. Open the right nostril, exhale slowly. After complete exhalation, again inhale through right nostril and close it with right thumb. Open the left nostril , breathe out slowly. This is one round of Nadisukthi Pranayama. Students were given Nadisuddi training for 5 mins daily for two months [8].

Parameters	Pre yoga (n=50)	Post yoga(n=50)	p value
VC(ml)	2972 ± 213.151	3372 ± 528.7722	p<0.005
TV(ml)	496 ± 84.06347	588 ± 150.8863	p<0.005
ERV(ml)	888 ± 183.303	1096 ± 386.7385	p<0.005
BHT(s)	33 ± 5.773503	58.6 ± 12.78019	p<0.005
40 mm endurance(s)	30.8 ± 5.139715	53.52 ± 15.68736	p<0.005
PEFR(l/min)	388.8 ± 15.36229	425.2 ± 38.74274	p<0.005

[Table/Fig-1]: Effect of pranayama and suryanamaskar on pulmonary functions in Medical students, ** Data were mean ± SD , *Significant value for p<0.05*

Kapalbhati: Kapalbhati Pranayama is a type of breathing exercise that helps you rid of various ailments over a period of time [9]. "Kapal" means forehead and "bhati" means shining. Kapalabhati is done in a sitting posture [10]. Focus on "exhaling". Inhale as normal. Exhale and simultaneously contract the abdomen muscles with each exhalation. Students were given Kapalbhati training for 5 mins daily for 2 months.

Bhastrika: Bhastrika is a Sanskrit word which means bellows. In Bhastrika pranayama, the breathing pattern resembles the blowing of bellows. Bhastrika pranayama is all about inhaling and exhaling completely so that your body gets maximum amount of oxygen [11]. Students were given Bhastrika training for 5 mins daily for 2 months.

Bramhari: The word "Bramhari" comes from the Sanskrit name bhramar which is humming black bee [12]. The practice of bramhari breathing calms the mind, reduces the stress or fight - flight response. In this pranayama one needs to create a sound while exhaling and inhaling in the throat. The sound is similar to chanting of Om, especially the long mmm. in Omkar. The sound should be deep, steady and smooth. Students were given Bramhari training for 5 mins daily for 2 months.

Pranava Pranayama: The Pranava is the full cosmic Om (or AUM), represented as the three distinct vibratory sounds of 'A' (ah), 'U' (oh) and 'M' (mm). The 'Ahh' sound originating from the solar plexus is related to lower lung breathing [13]. The 'Ohh' sound originating from the chest region corresponds to mid-chest breathing. The 'Mmm' sound, as it moves upward and transcends its auditory character is associated with upper lung breathing. Students were given Pranava Pranayama training for 5 mins daily for 2 months.

Surya Namsakar: Surya Namaskar has a deep effect in detoxifying the organs through copious oxygenation and has a deeper relaxing effect. It is a series of 12 physical postures [14]. These alternating backward and forward bending postures flex and stretch the spinal column giving a profound stretch to the whole body [15]. Students were given Surya Namaskar training for 3 mins daily for 2 months.

OM Chanting was done at the end of the yoga session daily 2 mins for 2 months.

RESULTS

The results of this study demonstrated the beneficial effect of pranayama on pulmonary functions.

The post readings of parameters such as VC, TV, ERV are increased significantly (p<0.005) following yoga practice. This indicates that there is some degree of broncho-dilatation, which is leading to better oxygenation of the alveoli. The post yoga readings of BHT, 40 mm endurance are also statistically improved. Results are shown in [Table/Fig-1].

Following the yoga practice, PEFR values are also statistically improved (p<0.005). The increased peak expiratory flow rate might be a consequence of small airway opening in lungs. From the [Table/Fig-1] we observed that there is a statistical improvement in the pulmonary functions following yoga practice. A p-value less than 0.005 was considered as statistically significant.

DISCUSSION

Pranayama helps in bringing the sympathetic and parasympathetic nervous system into harmony. Through breathing we can influence the nervous system. Pranayama may allow bronchio-dilatation by correcting abnormal breathing patterns & reducing muscle tone of respiratory muscles [16-18].

As shown in [Table/Fig-1], all the parameters show statistically significant improvement with regular practice of yoga. These effects can be explained on the following basis:

Yoga training improves the strength of expiratory as well as inspiratory muscles [19]. Bhastrika Pranayama is a bellows type breathing in which one breath forcefully and rapidly and thus, exercises inspiratory as well as expiratory muscles [7].

In breathing exercises like Kapalbhati, short powerful strokes of exhalation in quick succession with contraction of abdominal and diaphragmatic muscles train the subject to make full use of diaphragm and abdominal muscles in breathing. It also helps in removal of secretions from bronchial tree, clearing up respiratory passages and the alveoli making room for more air [7].

There has been a case report [20] of occurrence of pneumothorax with practice of Kapalabhati pranayama but there was no such occurence in our study. Yoga strengthens the respiratory musculature due to which chest and lungs inflate and deflate to fullest possible extent and muscles are made to work to maximal extent. Abdominal breathing uses the diaphragm and performs respiration with least effort. While, chest breathing utilizes intercostal muscles [18]. It is less efficient [21]. With the regular practice of breath holding the individual's central and peripheral chemoreceptor's gets adapted to the anoxia, this result is achieved by the body by causing hypo metabolism. Thus, reflecting as prolonged breath hold and decreased urge to breathe while doing so. In addition to this, the training of the stretch receptors in the respiratory muscles, chest wall and also walls of the alveoli support the breath holding [22]. Pranayama training causes an increase in the voluntary breath holding time. This may be due to acclimatization of the chemoreceptors to hypercapnoea [23].

Lung inflation near to TLC is a major stimulus for release of lung surfactant into alveolar spaces which increases the lung compliance [3]. During pranayama, there is slow & prolonged inspiration and expiration. It stretches elastin & collagen fibres interwoven among lung parenchyma. Hence these fibres elongate to a greater extent [24]. During pranayama training, regular inspiration and expiration for longer duration would lead to acclimatization of central and peripheral chemoreceptors for both hypercapnoea and hypoxia [25]. A study by Bhargava MR et al., showed a statistically significant increased breath holding time after the pranayama practice [26]. Acclimatization of the stretch receptors increase the synchronization between the lung tissue and the cortex. Continous pranayama training causes increased breath holding time [26,27]. Another possible explanation for the role of yoga in improving the functioning of Lungs and in reducing the mast cell degranulation could be based on the frictional stress from air flowing through narrowed airways damaging the airway mucosa and thereby perpetuating airway inflammation and airway obstruction. The slow and gentle breathing in some of the Pranayamas may reverse the process by reducing the frictional stress, and thereby stabilizing the mast cell degranulation [28].

A growing number of literatures have confirmed that endotoxin is the main mediator in byssinosis and obstructive lung diseases [29]. The deep inspiration, retention of air and slow expiration increases the overall capacity of the lungs and gradually improves the ventilatory functioning of lungs. Due to the proper working of these organs, vital energy flows to maintain the normal homeostasis of the body and thus it helps in prevention, control and rehabilitation of many respiratory diseases [30].

Thus this present study indicates that the regular practice of pranayama improves pulmonary function and is beneficial to improve respiratory efficiency.

CONCLUSION

After 2 months of yoga training, the readings of VC, TV, ERV, BHT, 40mm endurance, PEFR show significant increase. From the present study we may conclude that yoga practice can be advocated to improve pulmonary functions in healthy individuals and hence to prevent respiratory diseases in future. These benificial effect of pranayama can be used as an adjuvant therapy for many respiratory diseases. The daily practice could also be parts of physical fitness and life style modification programs in maintaining better physical and mental health. Hence, it can be said that pranayama improves respiratory breathing capacity by increasing chest wall expansion and forced expiratory lung volumes.

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PARTICULARS OF CONTRIBUTORS:
1. Under Graduate, Meenakshi Medical College Hospital & RI, Kanchipuram, Tamil Nadu, India.
2. Professor & HOD, Department of Physiology, Meenakshi Medical College Hospital & RI, Kanchipuram, Tamil Nadu, India.
3. Tutor, Department of Physiology, Meenakshi Medical College Hospital & RI, Kanchipuram, Tamil Nadu, India.
4. Post Graduate, Department of Anaesthesia, Meenakshi Medical College Hospital & RI, Kanchipuram, Tamil Nadu, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. P. Shaym Karthik,
B-7, Cheran Nagar, Kovilpalayam, Pollachi- 642110, Coimbatore, India.
Phone : 9790373715, E-mail : sharkshyam94@gmail.com

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