

Evaluation of Effect of Yoga on Pulmonary Functions and Hand Grip Strength in College Students

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ABSTRACT

Yoga is an ancient Indian philosophical discipline designed to bring balance and health and to increase longevity. To assess the beneficial effect of yoga to cope up with stress and to improve the overall health and performance of students, the present study has been carried out. The study design was a cohort study. The study was conducted in the Department of Physiology, Government Kilpauk Medical College, Chennai. 52 students in the age group of 17 – 22yrs were given yoga training for 4 weeks. 52 age and gender matched students formed the control group. Breath Holding Time (BHT), Forced Vital Capacity (FVC), Peak Expiratory Flow rate (PEFR) and Hand Grip Strength (HGS) were done for both study and control groups at baseline and at the end of 4 weeks. Statistical analysis was done using the paired student's "t" test. There was statistically significant improvement of Breath Holding Time (BHT), Forced Vital Capacity (FVC), Peak Expiratory Flow Rate (PEFR) and Hand Grip Strength (HGS) in the study group (group I) following 4 weeks of yoga practice ($p < 0.01$) while there was no significant change in these parameters in the control group (group II). The study concludes that regular yoga practice can improve the pulmonary functions as well as skeletal muscle strength of young individuals and this positive change could persist into their adulthood.

Keywords: yoga, students, Breath Holding Time, Forced Vital Capacity, Peak Expiratory Flow Rate, Hand Grip Strength

INTRODUCTION

In this modern era, everyone experiences stress because of highly competitive and challenging lifestyle. Yoga is an ancient Indian philosophical discipline designed to bring balance and health to increase longevity⁽¹⁾. The principles of yoga practice involves the adoption and maintenance of various psychophysical postures along with controlled breathing techniques. Yoga mainly consists of Asana (Posture – a particular position of the body which contributes to steadiness of

body and mind), Pranayama (Breathing technique – to control the breathing in a superior and extra – ordinary way to get maximum benefits) and Meditation⁽²⁾. By practicing them, one develops agility, balance, endurance, co-ordination and great vitality. It secures a fine physical structure and helps to keep the body free from diseases. It helps to develop the spirit of harmony by coordinating the mind and body of an individual. Yoga may be an important tool for every individual for maintaining health and improving quality of life.

Suryanamaskar is an essential component of yoga which provides all of the key health benefits of yoga. These are performed so that they alternately stretch the spine backwards and forwards along with breathing control. Breath is the dynamic bridge between body and mind⁽³⁾ and pranayama (breathing techniques) is one of the most important yogic practices, which can produce different physiological responses in healthy individuals

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(4). Pranayama is an art of prolongation and control of breath, which helps to bring the conscious awareness in breathing; to reshape breathing habits and patterns (3). The persistent conditioning of breathing pattern of pranayama increases the pulmonary function in healthy individuals (4).

Yoga has been reported to improve the pulmonary functions to a much greater extent as it involves physical activity as well as breathing exercise (5,6). Pulmonary function tests (PFT) serve as a tool of health assessment. Pulmonary functions are generally determined by the strength of respiratory muscles, compliance of the thoracic cavity, airway resistance and elastic recoil of the lungs. Vital capacity is a critical component of good health and its determination is important for normal subjects as well as for patients on treatment.

Hand grip dynamometry is a simple method to assess skeletal muscle function and nutritional status of an individual (7). They can also be used as objective clinical measures for determining the severity of disease process and effectiveness of rehabilitation programs. To attain healthy population, college campuses serve as crucial settings to implement effective interventions. If college students make positive changes in yogic practice, these changes could persist into their adult years. Many reports supported the beneficial effects of yoga training on pulmonary functions and skeletal muscle strength. To assess the beneficial effect of yoga to cope up with stress and to improve the overall health and performance of students, and also to highlight the advantages of yoga among college students, the present study has been undertaken.

MATERIALS AND METHOD

The study design was a prospective cohort study. This study was carried out in the Department of Physiology, Government Kilpauk Medical College, Chennai. Before starting the study, clearance was obtained from the Institutional Ethics Committee and College Authorities.

Student volunteers of either gender in the age group of 17 – 22 years were involved in the study. Students with respiratory, cardiac, endocrine, musculoskeletal ailments, sportspersons, students already practicing yoga and students with history of recent medication use were excluded from the study. After obtaining written informed consent from the willing students, clinical examination was carried out to rule out the presence

of co morbid illnesses. Our sample size was 104 of either gender, which was calculated based on Fleiss with continuity correction. They were divided into two groups of 52 students in each, using lottery method. Group I was the study group while Group II acted as the control group.

All the members of Group I underwent the same yoga training for one hour per day for a period of 4 weeks between 6 to 7 am under the guidance of a trained instructor. The subjects were taught to do meditation, yoga and pranayama. Meditation was done in sukhasana for 5 min and mild warming up for 5 minutes. Then 5 rounds of Suryanamaskar was practiced for 30 minutes. Each round has 12 postures in which each posture is maintained for 30 secs. Then Nadi sodhana (alternate nostril breathing), Bhastrika (rapid breathing), and Bhramari (honey bee sound during expiration) pranayamas were also carried out for 5 min each. Shavasana was performed at the end for 5 min.

Pulmonary function tests such as Breath Holding Time (BHT), Forced Vital Capacity (FVC), Peak Expiratory Flow Rate (PEFR) and Hand Grip Strength (HGS) were measured in both groups before and after the study period. All the tests were performed at the same time of the day between 8 to 9 a.m. to avoid the diurnal variations. Breath Holding Time was measured from the time of holding the breath after quiet expiration till the breaking point of the held breath by using a stop watch in comfortable sitting position. The subjects were asked to hold breath by closing both nostrils voluntarily by pinching nose between the thumb and index finger with closed mouth. Forced vital capacity (FVC) and Peak expiratory flow rate (PEFR) were measured using Easy on PC spirometer. After explaining and demonstrating the procedure, the subjects were asked to take a deep breath and blow it into the mouth piece of the spirometer. A nasal clip was used to prevent the air flow through the nostrils. Three readings were taken in sitting posture at an interval of 3 minutes and the best of three was taken for interpretation.

Hand Grip Strength of dominant hand was assessed using a Hand Grip Dynamometer (INCO India Ltd., Ambala). After explaining the procedure with demonstration, they were tested with the arms extended at shoulder level, horizontal to the ground. They were asked to squeeze the dynamometer with maximum isometric effort which is maintained for about 5 seconds.

The hand grip strength was recorded in kilograms as indicated by pointer on the dynamometer. Three readings were taken at an interval of 2 minutes and the best of three was taken for interpretation.

RESULTS

Statistical analysis was done using the paired student's "t" test. Data was expressed as mean with standard deviation for parametric values and as frequency

for non-parametric values. Results are showed with the p value.

Table No.1 shows the observations before and after 4 weeks in Group I. There was a highly significant increase in BHT, FVC & HGS and significant increase in PEFR in Group I subjects after yoga training. Table No.2 shows observations before and after 4 weeks in Group II. There was no significant change in BHT, FVC, PEFR and HGS in Group II subjects.

Table No. 1: Observations before and after 4weeks in Group I

PARAMETERS (Mean ± SD)	Baseline	After 4 weeks	P value
BHT (in sec)	44.11 ± 11.37	47.15 ± 11.63	<0.001
FVC (in L)	3.15 ± 0.67	3.20 ± 0.66	<0.001
PEFR (in L/s)	5.17 ± 1.37	5.76 ± 1.38	<0.01
HGS (in kg)	28.84 ± 10.04	30 ± 10.99	<0.001

Table No. 2: Observations before and after 4weeks in Group II

PARAMETERS (Mean ± SD)	Baseline	After 4 weeks	P value
BHT (in sec)	47.46 ± 13.59	46.82 ± 13.54	0.5078
FVC (in L)	2.95 ± 0.75	2.92 ± 0.72	0.1500
PEFR (in L/s)	5.65 ± 1.33	5.65 ± 1.33	0.2490
HGS (in kg)	27.2 ± 10.43	26.85 ± 10.48	0.0566

DISCUSSION

This study showed significant improvement in all studied parameters within a duration of four weeks, as our study population consisted of healthy young individuals. The results are consistent with studies conducted earlier by Madanmohan et al. ⁽⁷⁾, Parikh et al. ⁽⁸⁾ and Muller et al. ⁽⁹⁾ who proved the efficiency of yoga in improving pulmonary functions. Avadhany et al. have also conducted this study in pre pubertal children and found the same results ⁽¹⁰⁾.

Respiratory function depends on several factors, including chest expansion, lung dimensions, respiratory muscle strength, air way resistance and alveolar

surface area. The FVC is an index of the volume of the respiratory apparatus, whereas the PEFR is the rate of air flow during expiration. Yogic postures in Suryanamaskar involve sustained isometric contraction which is known to increase skeletal muscle strength. By strengthening and increasing the endurance of the respiratory muscles, chest and lungs inflate and deflate to fullest possible extent ⁽¹¹⁾. Pranayamas are used to calm the body, raise energy levels, increase respiratory stamina, relax the chest muscles and expand the lungs. Pranayama is characterized by slow and deep inhalation along with prolonged exhalation. The prolonged expiration and efficient use of abdominal and diaphragmatic muscles trains the respiratory apparatus to get emptied and filled

more completely and efficiently. This act of breathing stretches elastin and collagen fibers interwoven among the lung parenchyma which in turn decreases elastic resistance and increases compliance. The maximum inflation and deflation is an important stimulus for the release of surfactants and prostaglandins into the alveolar spaces, which lead to an increase in the lung compliance⁽¹²⁾. Stimulation of pulmonary stretch receptors by inflation reflexively relax smooth muscles of larynx and tracheobronchial tree⁽¹³⁾. As a result of increase in respiratory muscle strength, increase in lung compliance and decrease in bronchial smooth muscle tone, FVC and PEFr were increased following yoga training.

In this study, BHT increased at the end of 4 weeks which is similar to results of Karmur et al.⁽²⁾, Muller et al.⁽⁹⁾ and Ankad Roopa B et al.⁽¹⁴⁾. Breath-holding time depends on initial lung volume. Greater lung volume decreases the frequency and amplitude of involuntary contractions of respiratory muscles, thereby lessening the discomfort of breath holding. Practice of yoga makes the stretch receptors to withstand more stretching. Also the sensitivity of the respiratory center to carbon dioxide is reduced. Hence, respiratory center can withstand higher carbon di oxide concentrations. With continuous training, one can exercise voluntary control on the respiratory muscles overriding the excitatory stimuli to respiratory centers⁽²⁾.

Stress is an important precipitating factor of asthma, slow and deep breathing has a calming effect on the mind, which is not only helps to de-stress, but also improve the antioxidant status of the individual. Yoga is a form of mind-body medicine, which promotes positive affect and reduce negative affect to increase lung functions and reduce usage of bronchodilator in asthmatics⁽¹⁵⁾.

In the present study, HGS also increased following yoga training. This is consistent with the findings of Madanmohan et al.⁽⁷⁾ and Dash et al.⁽¹⁶⁾. Sustained isometric contraction of the shoulder, chest and arm muscles occur during steady state of yogic postures. The improvement in strength and endurance of these muscles can explain the significant increase in HGS^(7, 17). Raju et al. have noted that yoga training results in a significant increase in maximal work output with a significant reduced level of oxygen consumption per unit work⁽¹⁸⁾. The improvement in HGS following pranayama was ascribed to the oxygen requirement reducing effect of pranayama, as the availability of energy and oxidation of

glucose is believed to influence the HGS proportionately^(16,19).

Yoga practices might be interacting with various, somato-neuroendocrine mechanisms⁽¹⁹⁾ and it can be used as psychophysiological stimuli to increase endogenous secretion of melatonin, which improves sense of well-being⁽²⁰⁾. By reducing perceived stress and anxiety, yoga easing respiration and it can be beneficial in the prevention and cure of diseases⁽²¹⁾.

CONCLUSION

Regular yoga practice can lead to improvement in the pulmonary functions and skeletal muscle strength of young individuals and this positive change could persist into their adulthood. This resultant effect of yoga could be used to improve the lung functions and thereby help in the treatment of lung diseases like bronchial asthma, allergic bronchitis, post infectious recovery, tuberculosis and many occupational diseases. The increase in muscular strength may be useful for the treatment of Rheumatoid arthritis. We would like to extend our study by performing similar cohorts among population of asthmatics, chronic smokers and rheumatoid arthritis. To conclude, we can incorporate the practice of yoga in our daily schedule for healthy living.

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Ethical Clearance: Obtained

Abbreviations used in the study:

PFT – Pulmonary Function Test

BHT-Breath Holding Time

FVC- Forced vital capacity

PEFR- Peak expiratory flow rate

HGS – Hand grip strength

SD - Standard Deviation

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