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Original Article

Effect of breathing exercises on Pulmonary Function Tests in healthy adults

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Abstract

Background: Diaphragmatic breathing exercise (Bhastrika pranayama) is one of the significant breathing exercises. The present study was done to assess the changes in pulmonary function after three months of regular breathing exercises. ***Methods:*** . Fifty healthy volunteers (25 males and 25 females) of the age groups between 25 and 30 years were selected on the basis of inclusive and exclusive criteria. Recordings of Pulmonary Function Test (PFT) where taken by computerized spirometer before and after three months of regular breathing exercise. ***Results:*** There was significant changes ($P<0.01$ and $P<0.001$) in the observed values of parameters like FVC, FEV1/FVC, $FEF_{75-85\%}$, PEF, MVV and TV in both male and female healthy subjects. However, FEV1/FVC value was more significant in males than in females where has FVC value is more significant in females than in males. ***Conclusion:*** It was concluded that breathing exercise causes the significant increase several parameters of PFT. Breathing exercises probably causes increase in lung compliance, decrease in air ways resistance, strengthening of respiratory muscles and finally enhancement of pulmonary performance.

Key words: Pulmonary Function Test, computerized spirometer, Bhastrika pranayama

Introduction

Breathing is the most vital function for maintenance of life. It is thought by many cultures that the process of breathing is the essence of being. The goal of breathing exercises is to relax quickly and to improve the respiratory efficiency. Breathing exercises is the science of breath control. Breathing exercises (Pranayam) is derived from Sanskrit word (prana means breathe and ayama means development or control[(1)]. Among the many kinds of breathing exercises diaphragmatic or abdominal breathing exercises are considered as significant types of the breathing exercises[(2)]. Slow and deep inhalation through the nose, pause for a moment and then exhale forcefully through mouth is the characteristic feature of abdominal or diaphragmatic breathing exercises. Several studies had been conducted to prove the role of breathing exercises in the improvement of pulmonary functions in healthy individuals[(3-6)]. It improves respiratory functions and energy level throughout the day. Breathing exercises have been practicing for centuries. The physiological and psychological benefits of breathing exercises have been demonstrated in several studies. These studies have shown that regular practice of breathing exercises leads to improvement in physiological functions and human performance and also has several benefits on the various systems of the body[(7-9)]. Breathing exercises help in balancing and harmonizing the body, mind, and emotions[(10)]. Pulmonary function tests are used to assess the functional status of the lungs. The purpose of this study is to determine the effects of breathing exercises on pulmonary function tests in normal individuals.

Materials and methods

The study was conducted at Patanjali breathing exercises center, Tirupathi, Andhra Pradesh, India. Fifty healthy volunteers (25 males, 25 females) of the age group between 25-35 years were

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selected on the basis of inclusive and exclusive criteria. After taking informed written consent from each participant and explaining the purpose of study, a detailed history was taken. Subjects doing only breathing exercise during training were included and history of smoking, cardio – respiratory diseases, sports training, previous experience of yoga, major medical illness such as tuberculosis, hypertension, bronchial asthma were excluded from the present study.

Breathing Exercise

Breathing exercise training was imparted for three months by certified yoga instructor, diaphragmatic breathing exercise (Bhastrika Pranayama) involves deep and slow inhalation through nose and pause for a movement (usually to count of 1 to 10) followed by forceful exhalation through the mouth. The process may be repeated 5 to 10 times during practice and have to do several times a day. The details of practice in the sequential order were presented in the training center. The parameters of pulmonary function test were recorded before and after completion of three months breathing exercise training.

Pulmonary Function Tests

Pulmonary function tests (PFT) were performed by using computerized spirometer. The subject was asked to sit comfortably on chair and performed the said procedure during exhalation the subject should exhale forcefully as fast as possible into a sterile mouth piece of spirometer. The parameters such as forced vital capacity (FVC), forced expiratory volume in the first second(FEV1), FEV1/FVC, peak expiratory flow (PEF), forced mid expiratory flow in 0.25–0.75 seconds (FEF25- 75%), forced mid expiratory flow in 0.75–0.85 seconds (FEF75- 85%), Maximum voluntary ventilation (MVV) and tidal volume (TV) were automatically recorded by the computerized spirometer. The values of all tests were taken as % predicted as per age sex, height and whether subject is smoker or non smokers. The best of three reading was taken for interpretation. Statistical analysis was done by using Microsoft Excel and values were expressed as Mean and Standard Deviation (SD). Statistical significance level was evaluated by probability test (P values<0.05).

Results

In the present investigation different pulmonary parameters has been evaluated before and after the breathing exercise training (three months) and results has been represented by Table1 and Table 2. In these tables Group I and Group II are divided according to before exercise and after three months of exercise. Table 1 show the pulmonary function test for male adults and Table 2 shows the same for the female adults. Mean and SD of the predicted and observed values of the parameters (FVC, FEV_1, FEV_1 / FVC, FEF25-75%, FEF75-85%, and PEF) has been displayed according to computerized spirometer result sheets. Mean and SD of the only observed values of MMV and TV are also represent in both the table.

Among the all pulmonary parameters the observed values of maximum parameter like FVC, FEV_1/FVC, FEF75-85%, PEF, MVV and TV are shows significant (P<0.01) changes after three months of breathing exercise in both male and female subjects. However, the FEV_1/FVC value was more significant (P<0.001) in males than in females where as the FVC value is more significant (P<0.001) in females than in males.

Parameters		Group-I		Group-II		P' Value
		Mean	SD	Mean	SD	
FEV1	Predicted	3.08	0.52	2.96	0.58	0.56
	Observed	2.47	0.44	2.59	0.78	0.46
FVC	Predicted	3.95	0.042	3.50	0.66	0.02*
	Observed	2.84	0.76	4.00	0.50	0.01*
FEV1/FVC	Predicted	85.00	2.31	81.96	5.39	0.02*
	Observed	96.00	14.00	54.20	22.60	0.001*
$FEF_{25-75\%}$	Predicted	3.69	0.76	3.66	0.94	0.89
	Observed	4.20	0.98	4.46	0.80	0.33
$FEF_{75-85\%}$	Predicted	1.07	0.51	1.51	0.42	0.01*
	Observed	2.30	0.59	3.01	0.43	0.01*
PEF	Predicted	7.30	0.69	7.45	0.88	0.41
	Observed	7.08	1.47	8.31	1.23	0.01*
MVV	Observed	46.89	7.43	77.60	6.89	0.01*
TV	Observed	0.49	0.14	0.74	0.12	0.01*

*p<0.05 = statistically significant

Table :1 – Mean, SD and P values of different pulmonary parameters before (Group-I) and after breathing exercise (Group-II) of male individuals.

Parameters		Group-I		Group-II		P' Value
		Mean	SD	Mean	SD	
FE-V1	Predicted	2.63	0.24	3.02	0.45	0.01*
	Observed	2.12	0.45	2.39	0.85	0.19
FVC	Predicted	3.00	0.30	3.30	0.54	0.04*
	Observed	2.26	0.40	3.40	0.52	0.001*
FE-V1/FVC	Predicted	87.14	2.20	83.68	6.80	0.03*
	Observed	92.75	16.52	64.67	27.69	0.01*
FEF 25-75 %	Predicted	2.95	0.22	3.18	0.66	0.11
	Observed	3.51	0.74	3.51	1.33	0.99
FEF 75-85 %	Predicted	1.03	0.24	1.41	0.60	0.01*
	Observed	1.97	0.53	2.22	0.50	0.09
PEF	Predicted	5.26	0.37	6.21	0.92	0.01*
	Observed	4.83	1.57	6.82	2.17	0.01*
MVV	Observed	46.89	7.43	77.60	6.89	0.01*
TV	Observed	0.46	0.14	0.64	0.16	0.01*

*p<0.05 = statistically significant

Table :1 – Mean, SD and P values of different pulmonary parameters before (Group-I) and after breathing exercise (Group-II) of female individuals.

Discussion

From the present study it is evident that there is significant improvement in FVC, FEV_1/FVC, $FEF_{75\text{-}85\%}$, PEF, MVV after practicing breathing exercises (Bhastrika pranayama) for a period of three months by healthy males and females. These findings were supported by various studies [3, 4, 6]. The probable reason for the observations in the present study could bedue to the diaphragmatic breathing exercises. To breath diaphragmatically or with the diaphragm, one must draw air into lungs in such a way which will expand the abdomen and not the chest. Diaphragmatic breathing actually fills up the majority of the lungs with air much more than chest breathing. When diaphragm contracts it is forced downward causing the abdomen to expand. This causes a negative pressure within the chest forcing air into the lungs. The negative pressure also pulls blood into the chest which increases the venous return to the heart. This leads to increase stamina. In Bhastrika pranayama, as pulmonary pressure continues to increase it may provide in an adequate driving force to propel the blood to the upper most part of the lungs where ventilation of air is more which may result in more perfusion in lungs from top to bottom and thereby improving the ventilatory functions of lungs. In this study of three months of yoga practice, there was significant increase in FVC, and this finding is consistent with other studies [11, 12, 13]. On the other hand, Kumar et al [14] reported no such significant change. By consistently performing a variety of *asanas* muscles of the thoracic cavity are constantly being recruited. This recruitment may lead to greater musculature and thereby result in improved FVC [4, 10, 11]. Similar observations were made by Upadhyay et al [8] and they concluded that during pranayama, the compliance of the lung thoracic System increases and the airway resistance decreases.

Bhastrika pranayama involve isometric contraction and expansion of abdominal and intercostal muscles, which improve the strength of the intercostals muscles. Thus lead to increased FVC and FE-V1/FVC. Birkel DA [15] suggest that Pranayama increases frequency and duration of inhibitory neural impulses by activating pulmonary stretch receptors embedded in the smooth muscle of the airways, on activation causes inhibition of inspiratory neurons leading to inhibition of inspiration and alter blood flow through the lungs, thus improve ventilatory functions. In this study after three months yoga practice significant changes in FEV1/FVC, PEF, FEF75-85% and MVV. The probable reason for the observation could be, during breathing exercises (Bhastrika) the compliance of the lung thoracic system increases and the airway resistance decreases. It is believed that maximum deflation of lungs is an important physiological stimulus for the release of surfactant and prostaglandins in to the alveolar spaces which may increase lung compliance and decrease air flow resistance. In pranayama exercise, the efficient movement of diaphragm may lead to improve the forced expiratory volumes and capacities [16,17,18]. Kadu PP et al [19] observed that TV also significantly increased due to breathing exercise which strongly supported the present investigation. During breathing exercise there is more requirement of oxygen for the normal metabolism in respiratory muscle which may increase the TV. The regular breathing exercises over a period of months may recruit more number of alveoli which finally may increase PEF value.

Conclusion

The pulmonary function tests were performed by using computerized spirometer in 25 male and 25 female healthy individuals. The present study reveals the effect of breathing exercises on pulmonary function tests in normal healthy individuals. Significant changes in PFT that is FVC, $FEF_{75\text{-}85\%}$, PEF,

MVV, TV, PEF was found during diaphragmatic breathing exercisesby paired t-test. The increase in lung compliances and decrease in airway resistance may leadto improve the pulmonary ventilation. There wasno significant changes between males and females which suggested that the diaphragmatic breathing exercises were equally beneficial for both males and females. The cause for this could be the regular, slow, and deep inhalation and forceful exhalation during breathing exercises may improve voluntary control of breathing.Lung vital capacity was found to be increased after diaphragmatic breathing exercises. It implies the increase in physiological strength of the lungs. It can be stated that breathing exercises are beneficial particularly to improve pulmonary functions, even in normal healthy individuals.

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