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Research article

IMMEDIATE EFFECT OF SURYANADI PRANAYAMA ON PULMONARY FUNCTION (VENTILATORY VOLUMES AND CAPACITIES) IN HEALTHY VOLUNTEERS

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ABSTRACT

Objectives: we found only effects of at least a short term practice extended over a period of a few days to weeks of pranayama (alternate nostril breathing) rather than acute effects of unilateral right nostril breathing (suryanadi pranayama). Keeping this in mind the present study was designed to test the hypothesis that 10 min. of right nostril breathing have any immediate effect on ventilatory volumes and capacities in healthy volunteers. **Methodology:** Forced vital capacity (FVC), Forced expiratory volume in the first second (FEV_1), Forced expiratory volume percent (FEV_1/FVC%), Peak expiratory flow rate (PEFR), Forced expiratory $flow_{25\text{-}75\%}$ ($FEF_{25\text{-}75\%}$), Maximum voluntary ventilation (MVV), Slow vital capacity (SVC), Expiratory reserve volume (ERV), Inspiratory reserve volume (IRV) and Tidal volume (TV) were recorded before and after Surya Nadi Pranayama. **Results & Conclusion:** There was a significant increase in FVC ($p<0.0001$), FEV_1 ($p<0.0007$), PEFR ($p<0.0001$), $FEF_{25\text{-}75\%}$ ($p<0.0001$), MVV ($p<0.0001$), SVC ($p<0.0001$), ERV (0.0006), IRV ($p<0.0001$) and TV (0.0055) after suryanadi pranayama. The immediate effect of suryanadi pranayama practice showed alleviation of ventilatory capacities and volumes. Any practice that increases PEFR and $FEF_{25–75\%}$ is expected to retard the development of COPD's. The increase in PEFR, vital capacities and flow rates by suryanadi pranayama practice obviously offers an increment in respiratory efficiency and it can be advocated to the patients of early bronchitis and as a preventive measure for COPD.

Keywords: Pulmonary function, Suryanadi pranayama, immediate effect, ventilatory volumes and capacities

INTRODUCTION

Yoga is the best lifestyle, which aims to attain the unity of mind, body and spirit through asanas (exercise), pranayama (breathing), and meditation[1.] Pranayama, the fourth step of astang

yoga is an important component of yoga training[2]. Pranayama and Asanas are considered as important part which is prescribed by modern medicine too. Many physicians now recommend yoga to the patients at risk for heart diseases, as well as those with back pain, arthritis, depression and other chronic diseases[3].The beneficial effects of Pranayama are well reported and have a sound scientific basis. It was reported different types of Pranayama produce different physiological responses in healthy young volunteers[2,4]. Pranayama is a method of breathing and chest expansion exercise which has been reported to improve cardio respiratory function in health and disease[5,6]. The practice of pranayama has been known to modulate cardiac autonomic status with an improvement in Cardio respiratory functions[5, 7]. Autonomic nervous system consists of two branches i.e; sympathetic nervous system and parasympathetic nervous system. Although individual asana and pranayama practices can selectively affect sympathetic or parasympathetic nervous system, the overall effect of yoga practice is to bring a state of parasympathetic dominance[2,8,9]. The practice of breathing exercise increases parasympathetic activity and decreases sympathetic activity, improves cardiorespiratory functions by affecting oxygen consumption, metabolism and skin resistance[9-11].

Humans breathe preferably through one nostril at a time. Kayser defined nasal cycle as a phenomenon of alternating congestion, decongestion response of erectile tissues of nasal turbinate and septum of two nostrils, which effectively altered the unilateral nasal resistance and was existent on account of prevailing sympathetic and parasympathetic tone[12].The preferred nostril alternates in a simultaneous congestion-decongestion cycle. The nostril congestion-decongestion cycle is believed to reflect the dynamic lateralization of the autonomic nervous system[10,13]. Prolonged unilateral nostril breathing as a result of complete or partial nasal obstruction is correlated with a number of chronic disorders such as unilateral migraine, peptic ulcer, dysmenorrhoea, lack of libido, cardiac symptoms, fever, hyperthyroidism, asthma, inadequate oral intake and electrolyte imbalance[14]. It is believed that there is an activation of the contra lateral cerebral cortex with unilateral nostril breathing as evident from the rise in EEG amplitude[10, 14]. The right hemisphere is believed to play a major role in parasympathetic activity than the left hemisphere[13]. Left nostril breathing increases intraocular pressure (IOP) by 4.5% while right nostril breathing decreases IOP significantly[13,14] . Pranayama breathing through right nostril increases sympathetic activity, left nostril breathing reduces it.

Breathing exercises have been recommended in physiotherapy to improve respiratory and bowel function, in occupational therapy to facilitate spiritual emergence[5,6,13]. It has been assumed single nostril breathing can be used to therapeutically influence autonomic function and may significantly affect other hemisphere-specific functions[6,13]. Yoga practices can also be used as psycho-physiological stimuli to increase the secretion of melatonin which might be responsible for perceived well-being and has a calming effect on the mind, helps an individual to de-stress. These yoga practices might be interacting with various somatic and neuro-endocrine mechanisms bringing about therapeutic effects[9,15]. This calming effect may also exert profound physiological effects on pulmonary, cardiovascular, and mental functions of the brain[7,11].

The literature search through PUBMED central and other search engines, showed very scanty data on immediate effects of suryanadi pranayama on pulmonary functions. In our literature search, we found only effects of at least a short term practice extended over a period of a few days to weeks of pranayama (alternate nostril breathing) rather than acute effects of unilateral right nostril breathing (suryanadi pranayama). Keeping this in mind the present study was designed to test the hypothesis that 10

min. of right nostril breathing have any immediate effect on ventilatory volumes and capacities in healthy volunteers.

MATERIALS AND METHODS

Subject selection: This is a cross-sectional study carried out in the Pulmonary Function Testing Laboratory, Department of Physiology, Narayana medical college (NMC), Nellore (A.P), India. After obtaining approval of Institutional Ethics Committee (IEC), pulmonary function tests were conducted in 30 healthy volunteers in the age group of 18 to 40 years; age, BMI matched students and residents of NMC. The subjects of both genders were included. Subjects with a past history of smoking, hypertension, respiratory diseases, chest wall injuries, congestive cardiac failure, kyphoscoliosis and who are already trained in yoga and exercise were excluded from the study.

Study protocol: The volunteers were properly explained about the objectives, methodology, expected outcome and implications of the study and written informed consents were obtained from them. They were instructed to report to PFT lab of Physiology department at about 9 A.M. Their age, height, weight, was recorded and BMI calculated. Volunteers are trained to right nostril breathing (Suryanadi pranayama) by experienced yoga teacher from Narayana Yoga and Naturopathy College, and volunteers also get familiarized with our research lab and procedure of pulmonary function testing.

Methodology: Volunteers were asked to sit in a calm, quiet airy place in an easy and steady posture with the head, neck and trunk erect and in a straight line in order to keep the body still. Asked them to bring the right hand up to the nose, fold the index and middle finger in a way so that the right thumb closed the right nostril and the ring finger closed the left nostril (Vishnu Mudra)[12]. The volunteer was asked to close the left nostril by the ring finger and slowly breathe in up to a maximum, through the right nostril by counting 1to 6 over a period of 6 seconds and then and exhale slowly up to maximum over a period of 6 seconds. Recordings for pulmonary function parameters were taken before and after practicing suryanadi pranayama.

Pulmonary functions were assessed by computerized spirometer (Spirowin Version 2.0 of Genesis Medical systems pvt Ltd) which gives ERS-93 predicted values at BTPS conditions. After preliminary trials, a baseline reading was taken. Volunteers followed the instructions given by qualified and experienced yoga teacher for Suryanadi pranayama of 6 cycles/min for 10 mins. After practicing Suryanadi pranayama (6 cycles/min) for 10 min, the test was performed three times and the best reading was considered. During the procedure, the subjects inhaled deeply and then exhaled with maximum effort as much as possible into the mouthpiece for FVC test. The subjects inhaled deeply and exhaled slowly and completely as much as possible, this was repeated for 3-4 times followed by normal respiration for SVC test. The following parameters were recorded: Forced vital capacity (FVC), Forced expiratory volume in the first second (FEV_1), Forced expiratory volume percent (FEV_1/FVC%), Peak expiratory flow rate (PEFR), Forced expiratory flow 25-75% ($FEF_{25-75\%}$), Maximum voluntary ventilation (MVV), Slow vital capacity (SVC), Expiratory reserve volume (ERV), Inspiratory reserve volume (IRV) and Tidal volume (TV).

RESULTS

The data were expressed as mean ± SD, were analyzed using the GraphPad Instat Version3.0 for Windows, GraphPad Software, La Jolla California USA, www.graphpad.com. The Gaussian distribution of the data was determined. Normally distributed data were tested by the paired t-Test. Non-normally distributed data were tested with the Wilcoxon signed rank test. A value of $P<0.05$ was considered as significant.

Table 1 shows the anthropometric parameters of the subjects. Table 2 shows the respiratory

variables like ventilatory capacities, volumes and flow rates before and after suryanadi pranayama. There was significant increase in FVC ($p<0.0001$), FEV_1 ($p<0.0007$), PEFR ($p<0.0001$), $FEF_{25-75\%}$ ($p<0.0001$), MVV ($p<0.0001$), SVC ($p<0.0001$), ERV (0.0006), IRV ($p<0.0001$) and TV (0.0055) after suryanadi pranayama.

Table 1. Anthropometric parameters

S.no	Parameter	Mean ± SD
1.	Age (Yrs)	21.03 ±4.43
2.	Weight (Kgs)	54.9±11.56
3.	Height (m)	1.62 ± 0.09
4.	BMI (kg/m^2)	20.72 ± 3.28
5.	BSA (m^2)	1.57 ± 0.18

Table 2. Comparison of respiratory variables before and after suryanadi pranayama

S.no	Parameter	Mean ± SD		P value
		Before	After	
1.	FVC(L)	2.45 ± 0.49	2.75 ± 0.59	0.0001*
2.	FEV_1(L)	2.09 ± 0.49	2.30 ± 0.55	0.0007*
3.	FEV_1/FVC%	83.82 ±10.59	84.29 ± 9.38	0.79
4.	PEFR(L/S)	4.14 ± 1.32	4.32 ± 1.06	0.0001*
5.	$FEF_{25-75\%}$(L/S)	2.62 ± 0.79	2.67 ± 0.62	0.0001*
6.	SVC(L)	3.61 ± 1.93	4.47 ± 2.81	0.0001*
7.	ERV(L)	1.22 ± 1.18	1.70 ± 1.54	0.0006*
8.	IRV(L)	2.09 ± 1.85	2.87 ± 2.62	0.0001*
9.	TV(L)	0.92 ± 0.49	1.07 ± 0.43	0.0055*
10.	MVV(L)	69.39 ± 17.10	77.98 ± 19.65	0.0001*

FVC: Forced Vital capacity, FEV_1: Forced Expiratory Volume in 1 sec, PEFR: Peak Expiratory Flow rate, $FEF_{25-75\%}$: Forced Expiratory Volume, SVC: Slow vital capacity, ERV: Expiratory Reserve Volume, IRV: Inspiratory Reserve Volume, TV: Tidal Volume and MVV: Maximal Voluntary Ventilation. * signifies $p< 0.001$ which shows values are statistically significant.

DISCUSSION

Yoga is the ancient science which makes use of voluntary regulation of breathing to make respiration rhythmic, calm the mind to reach the ultimate goal[3,4]. A person practicing Pranayama will try to keep his attention on the act of breathing, leading to concentration which removes his attention from day to day worries and "de-stress" the individual[3,4].

Each cycle of suryanadi pranayama is a complex voluntary act, which includes two distinct phases, Puraka, and Rechaka i.e., inspiration & expiration. The technique of pranayama includes specific rules regarding the method of breathing, in terms of force of breathing, the duration of each phase of breathing, the number of rounds of pranayama and attention on breathing[16]. The various physiological changes occur during different phases of pranayama[16]. During pranayama, deep inhalation (puraka) stimulates

the respiratory system and fills the lungs with fresh air, retention of air (kumbhaka) raises the internal temperature and increase the absorption of oxygen, slow exhalation (rechaka) causes the diaphragm to return to original position, air full of toxins and impurities is forced out by contractions of intercostals muscles[4,16]. These are the main components of pranayama which massage the abdominal muscles and tone up the working of respiratory organs of body[4]. This deep inspiration, retention of air and slow expiration increases the overall capacity of the lungs and gradually improves the ventilatory functioning of lungs[4]. 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[4, 16]. These results are in line with the findings of Krogh and Lindhard, which might be the result of impulses from cerebral cortex influencing the respiratory centre[4].

From the results (table 2) it is evident that immediate effect of suryanadi pranayama showed significant improvement in FVC, FEV_1, PEFR, $FEF_{25-75\%}$, MVV, SVC, ERV, IRV and TV. FEV_1 is the volume of air that is exhaled in the first second during FVC manoeuvre. It is useful to detect generalized airway obstruction. FEV_1/FVC% is the volume of air expired in the first second, expressed as percentage of FVC. It is a more sensitive indicator of airway obstruction, than FVC or FEV_1 alone. $FEF_{25-75\%}$ is the average flow rate during middle 50% of FVC. It indicates patency of the small airways. $FEF_{25-75\%}$ depends on non-bronchopulmonary factors like, neuromuscular factors and mechanical equipment factors of inertial distortion of lungs. PEFR and $FEF_{25–75\%}$ are the first parameters to decline on many respiratory diseases. Healthy persons expire 70–90% of FVC in the first second of the test which means that they take about 5 second to expire the last 10–30% of the FVC[12]. Any practice that increases PEFR and $FEF_{25–75\%}$ is expected to retard the development of COPD's. Our results show the positive impact of suryanadi pranayama on PEFR and $FEF_{25–75\%}$.

These findings are similar to the study conducted by Nidhi Jain et al., Baljinder Singh Bal, Upadhyay et al. and Puja et al, showed a significant increment in Peak expiratory flow rate (PEFR) and $FEF_{25-75\%}$[12,14,15]. The increased PEFR might be a consequence of small airway opening in lungs. The number of minute alveoli in the lungs goes on increasing up to 8 yrs of age. After this the alveoli increases only in size and this is the ideal age to introduce pranayama[16]. The work of Yadav and Das attributed the increase in PEFR by yogic exercise due to following changes in respiratory dynamics i.e., Increased respiratory muscle strength, cleansing of airway secretions and efficient use of diaphragmatic and abdominal muscles, thereby emptying and filling the respiratory apparatus more efficiently and completely[3].

Previous studies also showed the effect of Pranayama on alleviation of the respiratory muscle efficiency and lung compliance by reducing elastic and viscous resistance of lung present during inspiration. Pranayama acts as physiological stimuli for release of lung surfactant and prostaglandins into alveolar spaces which increase the lung compliances. Our findings were consistent with the results of sivapriya etal., immediate increase in PEFR and increase in FVC, MVV, TV, Expiratory capacities etc[16].

CONCLUSION

The immediate effect of suryanadi pranayama practice showed alleviation of ventilatory capacities and volumes. The increase in PEFR, vital capacities and flow rates by suryanadi pranayama practice obviously offers an increment in respiratory efficiency and it can be advocated to the patients of early bronchitis and as a preventive measure for COPD.

Future Directions: Further research is required to determine whether forced nostril breathing has greater effects than relaxed single nostril

breathing, and whether the effects are greater if applied when a nostril is in its non-dominant phase of the nasal cycle.

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REFERENCES

1. Roopa BA**,** Anita Herur, Shailaja Patil, Shashikala GV, Surekharani Chinagudi. Effect of Short-Term Pranayama and Meditation on Cardiovascular Functions in Healthy Individuals. Heart Views. 2011;12(2): 58–62.
2. Madanmohan. Effect of slow and fast pranayamas on reaction time and cardiorespiratory variables. Indian J Physiol Pharmacol 2005; 49(3): 313-18.
3. Upadhyay Dhungel K, Malhotra V, Sarkar D, Prajapati R. Effect of alternate nostril breathing exercise on cardiorespiratory functions. Nepal Med Coll J 2008; 10(1): 25-27.
4. Shivraj P. Manaspure, Ameet Fadia, Damodara Gowda KM. Effect of selected breathing techniques on respiratory rate and breath holding time in healthy adults. IJABPT.2011; 2(3): 225-29.
5. Sukhdev Singh. Effects of a 6-week nadi-shodhan pranayama training on cardiopulmonary parameters. Journal of Physical Education and Sports Management. 2011; 2(4): 44-47.
6. Chanavirut R. Yoga exercise increases chest wall expansion and lung volumes in young healthy thais. Thai journal of Physiological sciences 2008; 19(1): 1-7.
7. Subbalakshmi NK, Saxena SK, Urmimala, Urban JA, D'Souza. Immediate effect of Nadi-Shodhana pranayama on some selected parameters of cardiovascular, pulmonary, and higher functions of brain. TJPS. 2005;18(2):10-16.
8. Madanmohan. Effect of six week yoga training on weight loss following step test, respiratory pressures, handgrip strength and handgrip endurance in young healthy subjects. Indian J Physiol Pharmacol 2008; 52 (2): 164-70.
9. Pal GK, Velkumary S, Madanmohan. Effect of short-term practice of breathing exercises on autonomic functions in normal human volunteers. Indian J Med Res.2004;120:115-121.
10. Ravinder Jerath, John WE, Vernon AB, Vandna Jerath. Physiology of long pranayamic breathing: Neural respiratory elements may provide a mechanism that explains how slow deep breathing shifts the autonomic nervous system.Med Hypotheses. 2006;67(3):566-71.
11. Shankarappa V, Prasanth P, Nachal Annamalai,Varunmalhotra. The short term effect of pranayama on the lung parameters. JCDR, 2012; 6(1):27-30.
12. Puja Dullo, Neeraj Vedi, Usha Gupta. Improvement in respiratory functions after alternate nostril breathing in healthy young adults. Pak J Physiol 2008;4(2):15-16.
13. Venthan JM. Single-nostril breathing to influence cognitive and autonomic Functions. Indian Journal of Physiotherapy and Occupational Therapy. 2008; 2(4):41-46.
14. Nidhi Jain, Srivastava RD, Anil Singhal. The effects of right and left nostril breathing on cardiorespiratory and autonomic parameters. IJPP 2005;49(4):469-74.
15. Baljinder Singh Bal. Effect of anulom vilom and bhastrika pranayama on the vital capacity and maximal ventilatory volume. J. Phys. Educ. Sport Manag. 2010;1(1):11-15.
16. Sivapriya DV, Suba Malani S, Shyamala Thirumeni. Effect of Nadi-Shodhana pranayama on respiratory parameters in school students". Rec. Res. Sci. Tech. 2010;2: 32-39