Original article

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A Comparative Study of Effect of Nadi-Shodhan Pranayama and Suryanamaskar on Pulmonary Functions

Fareedabanu A.B*, Darshit P. Shetty**

Abstract

Aims and Objectives: During recent years, lot of research work has been done to show the beneficial effects of yoga. Hence the, 1. Primary Objective - To study the effect of Nadi-shodhan pranayama (NP) & Suryanamaskar (SN) on Pulmonary Functions (PFs), 2. Secondary Objective - Comparison between the effects of two.

Materials and Methods: Fifty young healthy students (male & female) aged between 18-24 yrs of Government Ayurveda Medical College, Mysore were trained daily for 3 months. Students were divided into 2 groups of 25 each: Group I: students practising NP, 20 cycles for 20min. Group II: students practising SN, 10 cycles for 20min.Recording of Pulmonary functions {Vital capacity (VC), Forced expiratory volume at the end of first second (FEV1), Peak expiratory flow rate (PEFR) & Maximum voluntary ventilation (MVV)} were carried on computerized spirometer 'MEDSPIROR'& Respiratory rate was measured clinically, at the end of each month and after three months of training.

Results: Findings showed improvement in all Pulmonary Functions & a significant decrease in Respiratory rate in both the groups, but a statistical significant improvement was observed in VC, FEV1& PEFR in Group-I compared to Group II.

Conclusion: Present study suggests, practising of both NP & SN for a short period can produce significant improvement in all PFs by increasing respiratory muscle strength & endurance.

Key words: Endurance; Nadi-shodhan pranayama; Suryanamaskar.

Introduction

Yoga is an eternal science representing the universal need to evolve and transcend all limitations. Ancient mystics and seers discovered a way of connecting to the source of life within us. Yogic techniques are known to improve one's overall performance. The science and art of yoga has for millennia guided man in his search for truth. Modern man is the victim of stress and stress related disorders which threaten to disrupt his life totally. Being holistic in its approach, yoga offers the best way out of this 'whirlpool of stress'.1

Yogic lifestyle, yogic diet, yogic attitudes and various yogic practices help man to strengthen his body and mind and develop positive health, enabling him to withstand stress by normalizing the perception of stress, optimising the reaction to it and by effectively releasing the pent-up stress through various yogic practices. Living a happy and healthy life on all planes is possible through the unified practice of hatha yoga asanas and pranayamas, dharana and dhyana, especially when performed consciously and with awareness.

The word Pranayama is comprised of two parts 'prana and ayama'. Prana means 'vital energy' or 'life force', the force which exists in

Author's Affiliation: *Assistant Professor, Department of Physiology, Father Muller Medical College, Mangalore, Karnataka, India. **Assistant Professor, Department of Obstetrics & Gynaecology, K.S. Hegde Medical College, Mangalore, Karnataka, India.

Reprint's request: Dr. Fareeda Banu A.B, Assistant Professor, Department of Physiology, Father Muller Medical College, Mangalore, Karnataka, India.

Email: drfareedabanu.ab@gmail.com

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all animate and inanimate matters. Ayama is defined as 'extension or expansion'. Hence Pranayama means expansion of the dimension of prana. Nadi's are the psychic channels along which the vital forces of Prana flow. Shodhana means purifying. Hence the objective of Nadishodhan Pranayama (NP) is purification of the psychic network. Suryanamaskar (SN) is the combination of few Yogasana postures. This is well balanced set of movements that will stretch all the muscles in the body and keep the body & mind healthy.1

Scientific studies from JIPMER Pondicherry, AIIMS New Delhi and other laboratories have shown that the practice of yoga has beneficial effect on many physiological functions.2 These studies have shown that yoga has a sound scientific basis and is an ideal tool for improving the health of our masses. Many physicians now recommend yoga to patients at risk for heart diseases, as well as those with back pain, arthritis, depression and other chronic diseases.3

However, to put yoga on a firm scientific pedestal and popularize it among the general public, we planned to undertake a systematic study on the effect of Nadi-shodhan pranayama (NP) and Suryanamaskar (SN) on Pulmonary functions. So far, several studies have been done on these two and have revealed a beneficial effect on Pulmonary functions . As the studies on comparative effect of both NP and SN on Pulmonary functions are not reported, the present work was undertaken.

Materials and methods

The present study was conducted in Government Ayurveda Medical College, Mysore. Prior to the commencement of the study, permission from the Principal of Medical College and Institute Ethics committee were obtained.

Subjects

The study was carried out on 50 young healthy, 2nd & 3rd year BAMS students of 18-24yrs of age group including both male & female,. The nature of the study was explained to all the subjects and written informed consent was obtained from all of them. Pulmonary functions were tested using the instrument 'Medspiror' (a self calibrating computerized Spirometer that fulfills the criteria for standardized lung function tests) available in the Department of Physiology J.S.S.Medical College, Mysore.

The subjects were divided into two groups:

Group1 (n =25)- subjects practicing only Nadi-shodhan Pranayama

Group2 (n =25)- subjects practicing only Suryanamaskar

Methodology

The subjects of Group 1 & 2 were trained for Nadi-shodhan pranayama & Suryanamaskar respectively by an experienced, competent qualified Yoga teacher of Govt. Ayurveda Medical College, Mysore. The study protocol was for three months which include, Nadi-shodhan pranayama 20 cycles daily for 20 min & Practice of Suryanamaskar 10 cycles daily for 20 min by respective groups . Practice sessions were held between 4.30pm and 6pm, Monday to Saturday in a well lighted and properly aerated, calm and quiet Yoga room.

The subjects had no history of allergic disorders, respiratory disorders, no history of systemic disease and no history of smoking. History of systemic disease and respiratory disorder was ruled out by history and clinical examination.

Following parameters were recorded before and at the end of each month of training

- Vital capacity in litres (VC)

- Forced expiratory volume at the end of first second in liters (FEV1)
- Maximal voluntary ventilation in liters/ min (MVV)
- Peak expiratory flow rate in liters/sec (PEFR) and
- Respiratory rate was measured clinically in cycles/min

Procedure

The subjects were familiarized with the set up and detailed instructions and demonstrations were given to their satisfaction. The subjects were made to breath out forcefully following deep inspiration into the mouthpiece attached to the pneumotachometer. Expiration was maintained for a minimum period of 3-4 seconds. As recommended by Snowbird workshop all the readings were taken in standing position. All the tests were carried out at the same time of the day, between 4.30 pm to 6pm to avoid possible variations of circadian rhythm. The tests were done in a quiet room in order to alleviate the emotional and psychological stresses. Respiratory rate was counted clinically while the person is breathing, without the subject's awareness.

The basal parameters of the subjects of both the groups were compared with the results obtained after the training respectively and further comparison was done in between the results of two groups.

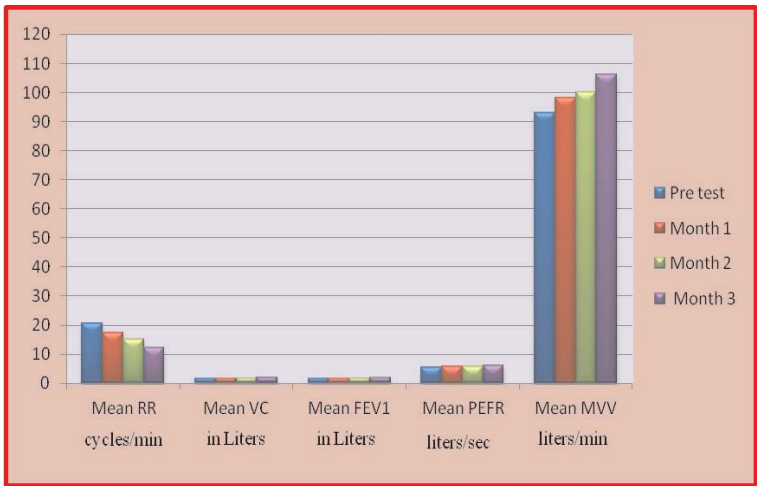
Statistical analysis like paired samples 't' test and repeated measure ANOVA were employed for data analysis for the present study using SPSS for Windows (version 16.0). The 'p' value less than 0.05 was considered statistically significant.

Table 1: Comparison of each month recording of RR, VC, FEV1, PEFR and MVV with that of first phase recordings in Group 1.All values are

Mean ±SD, n=25 (*: p<0.05).

Parameters	Duration	Mean± Std. Deviation	F	'p' value
	Pre test	20.73±3.574		
Mean RR	Month 1	17.32±3.62	146.002	.000*
	Month 2	15.18±3.37		
	Month 3	12.36±2.65		
	Pre test	1.54±0.27		
Mean VC	Month 1	1.73±0.34	18.980	.000*
	Month 2	1.82±0.43		
	Month 3	2.07±0.40		
	Pre test	1.58±0.31		
Mean FEV_1	Month 1	1.71±0.32	13.417	.000*
	Month 2	1.82±0.31		
	Month 3	2.02±0.45		
	Pre test	5.65±0.88		
Mean PEFR	Month 1	5.82±0.92	6.633	.001*
	Month 2	5.93±0.98		
	Month 3	6.14±0.79		
	Pre test	93.05±13.54		
Mean MVV	Month 1	98.14±13.86	9.583	.000*
	Month 2	100.18±14.51		
	Month 3	106.41±11.75		

Graph 1: Comparison of baseline Pulmonary functions of Group 1 with their each month reading for three months



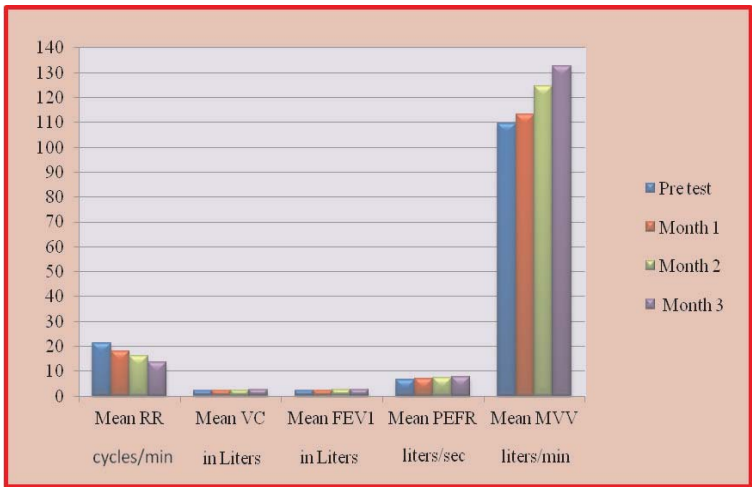
Statistically highly significant increase was observed in VC, FEV1, PEFR and MVV with significant decrease in RR at the end of each month in Group 1 practicing Nadi-shodhan pranayama on comparing with their baseline values.

Table 2: Comparison of each month recording of RR, VC, FEV1, PEFR and MVV with that of first phase recordings in Group2

All values are Mean ±SD, n=25(*: $p<0.05$).

Parameters	Duration	Mean± Std.Deviation	F	'p' value
	Pre test	21.14±2.75		
Mean RR	Month 1	18.09±2.45	146.177	.000*
	Month 2	16.27±2.19		
	Month 3	13.73±2.45		
	Pre test	2.04±0.69		
Mean VC	Month 1	2.23±0.68	52.215	.000*
	Month 2	2.38±0.69		
	Month 3	2.50±0.62		
	Pre test	2.08±0.68		
Mean FEV_1	Month 1	2.18±0.68	16.785	.000*
	Month 2	2.40±0.68		
	Month 3	2.49±0.54		
	Pre test	6.59±1.41		
Mean PEFR	Month 1	7.05±1.58	20.916	.000*
	Month 2	7.45±1.57		
	Month 3	7.84±1.50		
	Pre test	109.59±24.51		
Mean MVV	Month 1	113.27±33.61	16.039	.000*
	Month 2	124.45±27.68		
	Month 3	132.82±27.42		

Graph 2: Comparison of baseline Pulmonary functions of Group 2 with their each month reading for three months



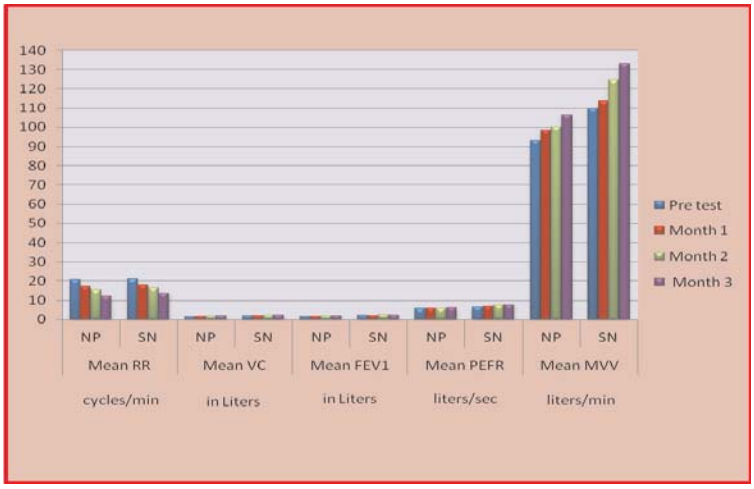
Statistically significant increase was observed in VC, FEV1, PEFR and MVV with significant decrease in RR at the end of each month in Group 2 practicing Suryanamaskar on comparing with their baseline values.

Table 3: Comparison of each month recordings of RR, VC, FEV1, PEFR and MVV between Group 1 and Group 2

All values are Mean ±SD, n=25 (*: p<0.05).

Parameters	Duration	Group1	Group2	't' value	'p' value
Mean RR	Pre test	20.73±3.574	21.14±2.75	-.426	.673
	Month 1	17.32±3.62	18.09±2.45	-.830	.412
	Month 2	15.18±3.37	16.27±2.19	-1.272	.211
	Month 3	12.36±2.65	13.73±2.45	-1.772	.084
Mean VC	Pre test	1.54±0.27	2.04±0.69	-3.173	.003*
	Month 1	1.73±0.34	2.23±0.68	-3.055	.005*
	Month 2	1.82±0.43	2.38±0.69	-3.197	.003*
	Month 3	2.07±0.40	2.50±0.62	-2.780	.008*
Mean FEV_1	Pre test	1.58±0.31	2.08±0.68	-3.086	.004*
	Month 1	1.71±0.32	2.18±0.68	-2.910	.006*
	Month 2	1.82±0.31	2.40±0.68	-3.701	.001*
	Month 3	2.02±0.45	2.49±0.54	-3.169	.003*
Mean PEFR	Pre test	5.65±0.88	6.59±1.41	-2.664	.011*
	Month 1	5.82±0.92	7.05±1.58	-3.155	.003*
	Month 2	5.93±0.98	7.45±1.57	-3.876	.000*
	Month 3	6.14±0.79	7.84±1.50	-4.692	.000*
Mean MVV	Pre test	93.05±13.54	109.59±24.51	-2.771	.008*
	Month 1	98.14±13.86	113.27±33.61	-1.953	.061
	Month 2	100.18±14.51	124.45±27.68	-3.643	.001*
	Month 3	106.41±11.75	132.82±27.42	-4.152	.000*

Graph 3: Comparison of each month recording of Pulmonary functions between Group 1 and Group 2



On comparing Group 1 and Group 2 more significant changes were observed in RR, VC, FEV_1, PEFR and MVV in Group 1 than Group 2 at the end of three months training of Nadi-shodhan pranayam and Suryanamaskar to respective groups.

Fig 1: Students Performing Nadi-Shodhan Pranayama

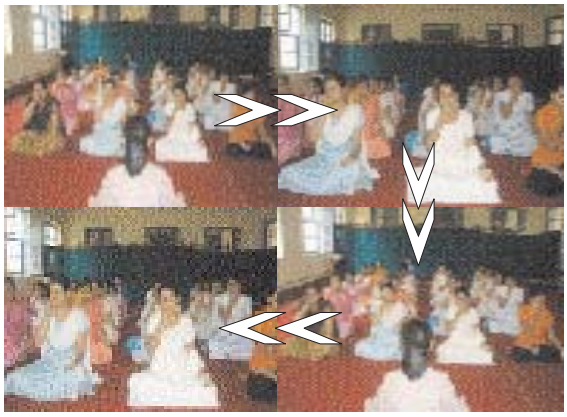


Fig 2: Students Performing

Results

Results showed that there was a significant increase in all Pulmonary functions i.e. VC, FEV1, PEFR and MVV where as significant decrease in RR in both the groups. On comparing between the results of two groups it was observed that the improvement in Pulmonary functions is statistically more significant in Group 1 compared to Group 2.

Discussion

With increased awareness and interest in health and natural remedies, yogic techniques including pranayama are gaining importance and becoming increasingly acceptable to the scientific community. Yoga and lifestyle interventions have been included with conventional therapy in the treatment of many clinical conditions and they have shown a 'positive outcome'. Yoga emphasizes on controlled breathing (pranayama), body posture (asana), relaxation of mind (meditation) keeps a person energetic & healthy for maintaining health and fitness and for treating diseases.4

Since yoga aims at perfection of the body and mind, it is natural to ask whether the progress towards perfection is reflected in objective reproducible changes in physiological variables. The present study involving 50 subjects though preliminary thus confirms that regular practice of NP and SN improves Pulmonary efficiency in healthy adolescents and is beneficial exercise for both males and females. The results are consistent with previous studies.

Regular practice of Pranayamic breathing improves ventilatory function of lungs as shown by increase in FVC, MVV, PEFR and increase in tolerance to CO2 as shown by prolongation of breath holding time and decrease in rate of respiration .5 Previous studies related to pulmonary function in regularly practicing 'Hathyoga' showed that, physiological reserve is increased with repeated practice of Yogic action with increase in vital capacity, resting tidal volume & breath holding time and decrease in resting RR 4 which is similar to present study.

Increase in PEFR among our volunteers may be due to rise in thoracic-pulmonary compliances and bronchodialation by training in NP. Stimulation of pulmonary stretch receptors by inflation of the lung reflexely relaxes smooth muscles of larynx and tracheobronchial tree; probably this modulates the airways caliber and reduces airway resistance. The 'Nadi-shodhan Pranayama' involves using of lung spaces, not used up in normal shallow breathing. Therefore, the increased PEFR might be a consequence of small airway opening in lungs.6 The work of Yadav and Das attributed the increase in PEFR by yogic exercise due to following changes in respiratory dynamics: increased respiratory muscle strength by the exercises of these muscles, cleansing of airways secretions and efficient use of diaphragmatic and abdominal muscles, thereby emptying and filling the respiratory apparatus more efficiently and completely.7

Significant improvement in all pulmonary function with significant decrease in RR could be mainly due to regulated, slow, deep and controlled breathing for prolonged period during pranayama practice leading to increase in the strength and endurance of expiratory as well as inspiratory muscles and contributing to enhanced voluntary control of breathing. As a technique, pranayama can assume rather complex forms of breathing, but the essence of the practice is slow and deep breathing. Such breathing is economical because it reduces dead space ventilation. 'It also refreshes air throughout the lungs, in contrast with shallow breathing that refreshes air only at the base of the lungs'.8

Although clear cut evidence is lacking, the mechanisms by which changes in respiratory functions occur are greater relaxation of respiratory muscles induced by 'supraspinal mechanisms' which increase expiratory reserve volume contributing to a rise in VC. Lung inflation to near total lung capacity is a

major physiological stimulus for release of 'surfactant and prostaglandin' into alveolar spaces. This causes increase in lung compliance and decrease in bronchiolar smooth muscle tone. 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.9 Which is consistent with the present study.

Suryanamaskar - The salutation to the Sun is also a part of Indian traditional yogic practices. It is used to worship the Surya (Sun) at the time of sun rise (can be done in evening when sun sets). Each cycle of SN is a sequence of certain 'asanas', performed along with 'pranayama'. The sequence of asanas is such that each asana is complimentary to the next. During SN, muscles of the entire body experience stretch and pressure alternately and therefore it is said to give more benefits with less expenditure of time. It is claimed that SN practice gives benefits of both asana and pranayama and improves general health and fitness.10

Savita singh et al showed a statistically significant improvement in SBP, DBP, FEV1, PEFR, MVV, Kst (lung compliance) and Raw (airway resistance) as compared to baseline in CAD patients after 3months of regular practice of pranayama and asanas.11Regular practice of Asana develops the elasticity of the chest cavity. The intake of oxygen per breathing is increased. The respiratory system is strengthened. The supply of more oxygen to each and every cell of the body keeps away all the ailments of the 'five senses'. It is useful to treat sensory deprivation at its initial stage. It relieves us from mental and physical fatigue and help in controlling heart beats at normal rate.12

Regular yogic practices strengthen the respiratory muscles; increase the excursions of diaphragm and lungs as well as thoracic compliance'. Also yogic practices decrease airway resistance. All these factors contribute to improvement in the various lung function tests after regular practice of SN. Yogic practices also improve respiratory muscle endurance. 40mm endurance test, which also showed statistically significant improvement, indicates better respiratory endurance in both the groups after regular practice of SN.2

Yogic asanas and pranayama have been shown to reduce the resting respiratory rate and increase vital capacity, timed vital capacity, maximum voluntary ventilation, breath holding time and maximal inspiratory and expiratory pressures.13 Regular practice of Asanas together with Pranayama enhances the strength and force of contraction of respiratory muscles like diaphragm and upper abdominal muscles resulting in improvement of MVV and PEFR.11

Hence daily practice of both Suryanamaskar and Nadi-shodhan pranayama could also be part of physical fitness and life style modification program in maintaining better physical and mental health.

Conclusion

India has a rich tradition of yogic practices. Now-a-days yoga, the ancient practice of postures, breathing and meditation is gaining a lot of attention from healthcare professionals. From this study, we concluded that the practice of both Suryanamaskar & Nadi-shodhan pranayama improves the respiratory efficiency by enhancing vagosympathetic balance. But here the results were more promising with Nadi-shodhan pranayama than Suryanamaskar.

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