Recent Research in Science and Technology 2010, 2(11): 32-39
ISSN: 2076-5061
www.recent-science.com

PHYSIOLOGY

EFFECT OF NADI SHODHANA PRANAYAMA ON RESPIRATORY PARAMETERS IN SCHOOL STUDENTS

Sivapriya D V[1*], Suba Malani S[2], Shyamala Thirumeni[1]

[1]*Department of Physiology, Saveetha Medical College & Hospital, Saveetha University, Saveetha Nagar, Thandalam, Chennai – 602 105, Tamilnadu, India*
[2]*Department of Physiology, Tagore Medical College & Hospital, Rathinamangalam, Chennai – 600 048, Tamilnadu, India*

Abstract

Background: Yogic breathing techniques are very important for inducing relaxation. It is thought by many cultures that the process of breathing is the essence of being. The ultimate goal is to relax quickly and to improve the respiratory efficiency. It's important for children to practice yogic breathing techniques on a daily basis. Breathing techniques help to change subtle energies within the body for health and well being. Modern human is the victim of stress and now a days yoga is widely used among adult population to relive stress but leastly concentrated in children inspite of its vast effects. Aim: Current study was undertaken to create awareness in the health benefits of pranayama and to inculcate yoga in school students so that they can gain a healthy life in future. Methods: This study was designed to evaluate the effects of a 45 days daily practice of Nadi Shodhana Pranayama yoga practice on peak expiratory flow rate (PEFR), forced vital capacity (FVC), forced expiatory volume in 1 sec (FEV1) and respiratory rate (RR) in school students of both sexes. 115 school students aged 8 – 14 years studying in Visa Nursery & primary school, Chennai were recruited for the study. Healthy student with no history of present and past illness were selected. The participants were trained to perform Nadi Shodhana Pranayama and the study was done for 45 days . The respiratory parameters PEFR, FVC, FEV_1 & RR were measured before and after practice of Pranayama. Results: The results of this study showed significant increase in PEFR, FVC, FEV_1. The RR declined after the practice of Nadi Shodhana Pranayama. Conclusion: The positive results found in the present study can be applied to all schools to improve the pulmonary functions of the students . A few minutes practice daily may help in setting the mind better on works and studies. The daily practice could maintain better physical and mental health to have a better future.

Keywords: Nadi Shodhana Pranayama , Peak expiratory flow rate (PEFR) , Forced vital capacity (FVC), Forced expiratory volume in 1 Sec.(FEV1) & Respiratory rate (RR)

Introduction

Breath is life and life is breath. Breath is the key to the mystery of life, says Lama Angarika Govinda. A human lifetime is measured from the first to the last breath. The process of life itself depends on how we breathe. Breathing is not only an instinctive reflex to satisfy the need of the body for oxygen but it has been considered that consciously controlled breathing can be used as a technique for enhancing mental and physical powers[1]. Special and specific breathing techniques called pranayama have been evolved in yoga to transcend the limits of our physical and mental abilities experienced in our every day life.

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. Pranayama' is a Sanskrit word - Prana and Ayama. 'Prana' means life or life force. 'Ayama' means development or control. Therefore Pranayama is the development and control of life force[2]. It is a form of breathing exercise, very important in yoga. There are various types of Pranayama. Some of the popular forms are Ujjayee, Shitali, Anuloma -Viloma or Nadi Shodhana, Kapalabhati, Suryabhedana, Bhastrika etc. A yogi, through pranayama, can, at some stages, control other functions of his body and finally control manifestations of prana even outside his body.

Nadi shodhana pranayama

Prana, the vital energy pervades the whole body, following flow pattern called Nadis, which are responsible for maintaining all individual cellular activity. The word Nadi means 'channel' or flow of energy and shodhana means purification. Other names: Alternate nostril breathing, Anuloma – viloma pranayama. Nadi shodhana therefore means that practice which purifies the body. The effect of Nadi shodhana pranayama on respiratory system: decreases the work of breathing, strengthens and trains the diaphragm and other respiratory and abdominal muscles, improves gas exchange and oxygenation, provides good breath control and provides effective coughing. Other effects are reduces stress, gives more relaxation, gives energy and vitality and improves overall health and well-being.

* Corresponding Author, *Email:* senthil874@yahoo.com

Editor: Dr. Krishna Mohan Surapaneni

Practice of Nadi shodhana enhances voluntary regulation of the breathing to make respiration rhythmic and to calm the mind. The practice of Nadi shodhana is an art of controlling the breath. During the practice the subject tries to keep his or her attention on the act of breathing leading to concentration which in turn de- stress the subject and improves the pulmonary functions.

The responses of Alternate Nostril Breathing (ANB) the Nadisudhi Pranayama on some cardio-respiratory functions were investigated in healthy young adults. The subjects performed ANB exercise (15 minutes everyday in the morning) for four weeks. Cardio-respiratory parameters were recorded before and after 4-weeks training period. A significant increment in Peak expiratory flow rate (PEFR L/min) and Pulse pressure (PP) was noted. The decrease in pulse rate (PR), respiratory rate (RR), diastolic blood pressure (DBP) were significant. Results indicate that regular practice of ANB (Nadisudhi) increases parasympathetic activity[3]

Characteristics of Nadi Shodhana Pranayama

Pranayama essentially consists of a voluntary control on the breathing and probably due to this fact; many people refer it to as a breathing exercise. One remains fully aware of what he is doing during different phases of pranayama. In other words, pranayama is never done mechanically. Awareness of breathing is most important while practicing pranayama. No other bodily action is associated with pranayamic phases.

It is normally done in a relaxed sitting condition in which the demand for oxygen from the body is minimal. Each cycle of pranayama is a complex voluntary act, consisting of 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.

The various physiological changes occurring during different phases of pranayama are :

Puraka Phase or inspiration phase:

During the phase of puraka the lungs are expanded considerably and the walls of alveoli are stretched maximum. After a particular degree of stretching, the stretch receptors situated in the alveolar walls are stimulated. In normal breathing, at the stage or even before this, the inhibitory impulses would have been sent to the inspiration center and the phase of exhalation would have been started in a reflex. But as we continue the phase of inhalation by our strong voluntary control, the normal stretch reflex is inhibited and therefore no exhalation is possible. The chest continues to get expanded under cortical control. The stretch receptors are thus trained to withstand more and more stretching. During this phase the intra-pulmonary pressure is also raised. The diaphragm does not move freely as the abdomen is kept slightly inward and controlled. Therefore the alveoli in the upper pulmonary part are filled with air. One uses the inspiratory capacity for prolonged phase of puraka. This has a beneficial effect on the gaseous exchange, which then works efficiently throughout the day. Puraka is not merely a mechanical prolongation of inspiration but it is done with full concentration of mind.

Rechaka Phase or expiration phase:

Rechaka is a voluntarily controlled exhalation as compared to normal exhalation. The time (duration), force, ventilation and the flow of air are controlled in order to increase the duration of rechaka as per the time ratio. The exhalatory force is reduced and the air is allowed to escape slowly. For this purpose, exhalation is carried out through one nostril only thus by creating a slight airway restriction, and one can regulate volume of air to be expelled out per unit of time. This helps in prolongation of exhalation and to reduce the force of outgoing air. In rechaka, one uses expiratory reserve volume for exhaling completely before starting the next puraka phase. In this phase the intra-pulmonary pressure slowly reduces and the alveoli are gradually deflated. By this time when one is exhaling slowly the percentage of carbon dioxide is still increasing in the blood and the chemo receptors in the medulla are trying to inhibit exhalation and to start inhalation by stimulating the inspiratory center. Similarly the peripheral chemo receptors are also trying to bring about inspiration in a reflex as they are sensitive to the lower oxygen concentration in the blood[4].

Children are naturally fascinated by their own breathing, just getting quiet and paying attention to it is extremely soothing. Rather than thinking about the events and worries of their day, as children focus on their own breath, their minds become quiet. Their breathing will also automatically slow down and deepen, bringing more oxygen into their bodies and helping them to relax. They don't need to try to change their breath in any way. In fact, they don't have to do anything. They will just be watching the breath as it breathes itself.

According to Swami Sathyanadha Saraswathi[5] yoga education can be started at the age of 8 years. The significance of this age is becoming apparent to the modern scientists, who recognize that the physiological and psychological development of each individual, marking the beginning of the transition of awareness from childhood to adult life. Number of facts have been discovered by scientists, that concentration of yoga for children has many advance physiological and psychological effects. Galantino et al[6] showed that there is definite physiological benefits of yoga for the pediatric population that may benefit children through the rehabilitation process.

Methods

115 healthy school students aged 8 to 14 years of both sexes were included in the study. Sample was selected by Random sampling - lottery method. After getting the consent from the parents or guardian, they were involved in the study. A health check up was conducted for all the participants before the start of the study.

Inclusion Criteria

Healthy participants aged 8 to 14 years.

Exclusion Criteria

Participants with acute respiratory illness, respiratory disorders, participants on any form of respiratory medication, congenital heart disease, epileptic, recent injury or immobilization, physically challenged, spinal deformities were excluded from the study.

Withdrawal Criteria

Participants with acute illness, lack of interest and with asentism were with drawn from the study.

Prior to the training the Base line data were collected for all the subjects. It included following parameters - Name, age, sex, Peak expiratory flow rate using Mini – Wright's peak expiratory flow meter, Vital capacity & forced expiratory volume in 1 sec (FEV_1) using digital Spirometer and Resting respiratory rate by manual method.

Various instruments to measure pulmonary function such as dry spirometer McKesson vitalor and Wright's peak flow meter are inexpensive and portable and can be used efficiently without much specialised training. With Wright Peak flow meter, PEFR is perhaps the fastest and easiest single breath pulmonary function test available (Pande A H).[7] The peak expiratory flow rate is a feasible, stable, and useful measure of ventilatory capacity in preschool children.[8] Trial on children between 2 years 4 months and 4 years 9 months showed that good reproducible results for peak expiratory flow rates could be obtained from children over the age of 3 years using the low-range Wright Peak Flow Meter.[9]

V.K Vijayan [10] et al have conducted Pulmonary function tests (spirometry and maximal expiratory flow rates) South Indian healthy children between 7-19 years of age to predict pulmonary function. The correlations of forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1) were, in general highest with height followed by weight and age. Peak expiratory flow rate (PEFR) also significantly correlated with physical characteristics.

Eigen H[11] et al have done a research to find Spirometric pulmonary function in healthy preschool children ages 3 to 6 yrs. 82.6% of participants were able to perform technically acceptable and reproducible maneuvers during a testing session limited to 15 min. PEFR, FVC, FEV_1, and FEF 25-75 all increased with increasing height; the final outcome of the study is that spirometry can be obtained in the majority of preschool children.

Many preschool - aged children are able to perform technically acceptable and repeatable spirometry under normal conditions in a busy clinical setting. Spirometry may be a useful screen for abnormal lung function in this age group.[12]

PEFR - The participant was made to sit comfortably and relax for few second and then taught to hold the flow meter without obstructing the needle. Three readings were taken and the maximum peak flow rate was considered as final reading.

FVC & FEV_1 - Forced vital capacity & forced expiratory volume in 1 sec (FEV_1) was measured using digital spirometer. The measurements were performed with the participants seated comfortably. Before the measurements were taken, each participant was given information about the tests, rested in a comfortable chair for at least 10 minutes, and once the participant becomes accustomed to breathing through the apparatus then the procedure was started. Children disposable mouth piece was used. The participant was instructed to take a full breath in, (nose clip was applied) then the participant closes the lips around the mouth piece and blow out as hard and fast as possible. Inspiration should be full and unhurried and expiration once begins should be continued without a pause

All measurements were made under the same conditions and repeated at least twice; the highest value obtained was used & acceptable reproduciable curves of FVC and FEV_1 volumes were recorded.

After assessing the parameters Nadi – Shodhana Pranayama training was given by yoga trainer for ten days along with the warm up exercises (neck flexion, extension rotation, shoulder brazing, shrugging movements). Once the children were good enough in doing the Nadi shodhana pranayama, the 45 days study program was started. Practice started at 3.00 pm (3 hours after lunch, as practice should be done on an empty stomach) in a clean, quiet, and pleasant room. First warm up exercises were done followed by assuming pranav mudhra and then the three steps of Nadi Shodhana Pranayama practice was done each step 5 times with equal interval. Practice duration was 30 min each day.

Pranav Mudra[5]

Before Nadi Shodhana Pranayama practice subjects were taught how to hold the pranav mudhra. Open the right palm of the dominant hand, fold down the index and middle finger keeping the thumb straight. Right nostril closed with the help of thumb and the left

nostril closed with the help of ring and little finger. This is pranav mudra.

Technique Of Nadi Shodhana Pranayama[5]

Step 1: Close the right nostril with thumb

Inhale & exhale through the left nostril and repeat it for 5 times.

Lower the hand and breath through both nostril for 5 times.

Step 2: Close the left nostril with ring & little finger

Inhale & exhale through the right nostril and repeat it for 5 times.

Lower the hand and breath through both nostril for 5 times.

Step 3: Close the right nostril with the thumb

Breath in through the left nostril

Close the left nostril and

Breath out through the right nostril, repeat for 5 times

Lower the hand and breath through both nostril for 5 times

The inhalation and exhalation phases in nadi shodhana pranayama are called Puraka – inhalation and Rechaka – exhalation.

After 45 days of regular practice of Nadi shodhana pranayama, all the above parameters were reassessed.

Statistical analysis

All the values obtained before and after performing 'Nadi-shodhana Pranayama', rest and quiet breathing were expressed as mean ± SD. The student paired 't' test was used to compare pre and post training values. P values of less than 0.05 were accepted as significant difference between the compared values.

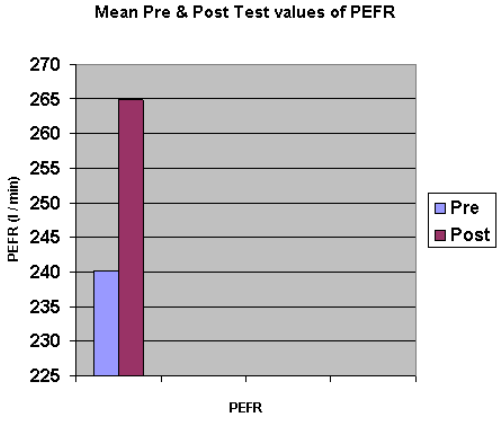
Results

Table I & fig 1 shows significant improvement in PEFR after the practice of pranayama

Table – I: Mean pre and post test value of PEFR

Serial no:	Parameter	Pre test value Mean ± 1 SD	Post Test Value Mean ± 1 SD
1	Peak expiratory flow rate (litres / min)	240.2 ± 19.6	264.7 ±20.4

Fig. 1 Effect of training in Nadi Shodhana Pranayama on PEFR (Pre) and (Post) After 45 days



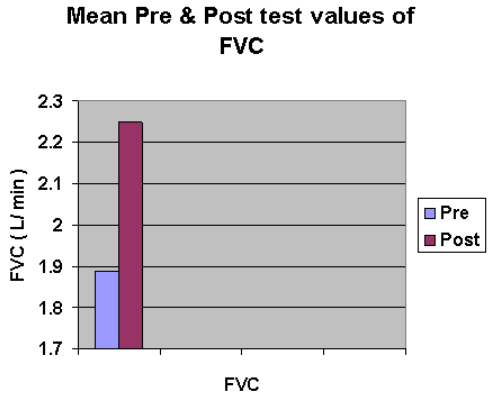
Result of the intervention shown in Table II & Fig 2.

- A statistically significant change in the FVC.

Table – II: Mean pre and post test value of forced vital capacity

Serial no:	Parameter	Pre test value Mean ± 1 SD	Post Test Value Mean ± 1 SD
1	Forced Vital Capacity (litres)	1.89 ± 0.29	2.25 ± 0.28

Fig. 2 Effect of training in Nadi Shodhana Pranayama on FVC (forced vital capacity) (Pre) Before (Post) After 45 days

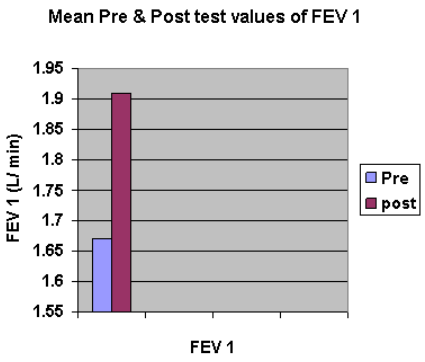


A statistically significant increase in the FEV_1 is shown in Table III & Fig 3

Table – III: mean pre and post test value of FEV_1

Serial no:	Parameter	Pre test value Mean ± 1 SD	Post Test Value Mean ± 1 SD
1)	Forced Expiratory Volume in 1sec	1.67 ± 0.36	1.91 ± 0.29

Fig. 3 Effect of training in Nadi Shodhana Pranayama on Forced expiratory volume in first 1 sec (FEV_1), (Pre) Before and (Post) After 45 days



Significant decline in respiratory rate show in

Table IV & Fig 4

Table – IV: Mean pre and post test value of respiratory rate

Serial no:	Parameter	Pre test value Mean ± 1 SD	Post Test Value Mean ± 1 SD
1)	Respiratory rate	21.91 ± 2.19	20.19 ± 1.50

Fig. 4 Effect of training in Nadi Shodhana Pranayama on Respiratory Rate (RR), (Pre) Before and (Post) After 45 days

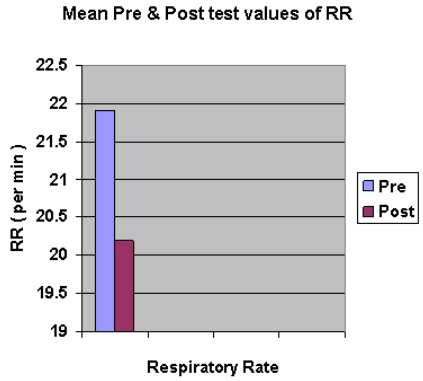


Table V: Effect of nadi shodhana pranayama on respiratory parameters in children. Data were mean ± SD; n = 115

S.NO	Parameters	Before Pranayama	After Pranayama	Mean difference	't' value
1)	Peak expiratory flow rate (litres / min)	240.2 ± 19.6	264.7 ±20.4	24.5 ± 0.8	16.4***
2)	Forced Vital Capacity (litres)	1.89 ± 0.29	2.25 ± 0.28	0.36 ± 0.01	29.5***
3)	Forced Expiratory Volume in 1sec	1.67 ± 0.36	1.91 ± 0.29	0.24 ± 0.07	15.6***
4)	Respiratory Rate (per/min)	21.91 ± 2.19	20.19 ± 1.50	1.72 ± 0.69	14.2**

*** $p < 0.0001$, **$p<0.001$

The intervention shown in Table V states the overall values of respiratory parameters measured. Among the parameters FVC, FEV_1 & PEFR was significantly increased while the RR was moderately decreased after the practice of Nadi Shodhana Pranayama.

Discussion

Yoga begins by working with the body on a structural level. The yogic practices stimulate and balance all the systems of the body. The end result is increased mental clarity, emotional stability and a greater sense of well being. Yoga practice have been proposed to, increase in PEFR (Udadhvay et al, 2008)[3]. In our study the PEFR increased after pranayama which was statistically significant. The peak expiratory flow rate increased significantly when measured immediately followed by Nadi Shodhana Pranayama practice[13]. In our study the increase was very significant since the study duration was 45 days.

The respiratory parameter PEFR was measured in our study using mini wright's peak flow meter and reproducible results was produced in age group of 8 to

14 in accordance to Iraj Mohammadzadeh[14] who proved PEFR can be measured simply in children.

A significant improvement in peak expiratory flow rate was observed in the present study. The increase is statistically significantly ($p < 0.0001$). It is an effort independent flow and is mainly dependent on lung volume. The 'Nadi shodhana Pranayama' involves using of lung spaces, which is not used up in normal shallow breathing. Therefore, the increased peak expiratory flow rate might be a consequence of small airway opening in lungs. The number of minute alveoli in the lungs goes on increasing until the age of eight. After this the alveoli increases only in size and this is the ideal age to introduce pranayama.[4] The results of the present study not only demonstrated the beneficial effect of Nadishodhana pranayama on the PEFR but also demonstrated its positive impact on the other parameters.

The respiratory parameter FVC & FEV_1 showed significant increase in our study. The study undertaken to assess the effects of yogic practice on some pulmonary functions showed a significant increase in FVC, FEV_1 and PEFR at the end of 12 weeks of yogic practices.[15]

Yogic asanas and pranayama increase vital capacity, timed vital capacity, maximum voluntary ventilation, breath holding time and maximal inspiratory and expiratory pressures in adult.

Our study also showed significant decrease in the respiratory rate in 45 days of practice. Alternate Nostril Breathing or the Nadi Shodhana Pranayama significantly increases Peak expiratory flow rate & respiratory rate significantly decreased.[16]

The respiratory parameters FVC & FEV_1 in our study produced technically acceptable and reproducible curves in accordance to the study in children aged 3 to 6 years to find, FVC , FEV_1 and FEF 25-75 (Eigen H)[11].

PER, FVC, FEV_1 showed significant increase in our study. There is reduction in sympathetic reactivity and improvement in pulmonary functions with practice of pranayama. This may allow bronchodilatation by correcting the abnormal breathing patterns and reducing the muscle tone of inspiratory and expiratory muscles which leads to better oxygenation of alveoli. Due to improved breathing patterns, respiratory bronchioles may be widened and perfusion of large number of alveoli can be carried significantly.[17] Nadi Shodhana Pranayama is an ideal tool to improve the respiratory functions in children.

Conclusion

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.

Practice of Nadi shodhana enhances the respiratory function in school students. The PEFR, FVC, FEV_1 showed significant improvement after 45 days practice and the respiratory rate declined after 45 days.

The positive results found in the present study might be apply to all school to improve the pulmonary functions in students. A few minutes of practice daily may help in setting the mind better on works and studies. The daily practice could also be parts of physical fitness and life style modification programs in maintaining better physical and mental health to have a better future.

Yoga not only has physiological effects but also improves the well being of the child. Hence, the study strongly recommends that yoga and pranayama should be introduced as a compulsory discipline in all schools.

References

1. Gharote M L: Pranayama – the science of breath-theory and guidelines for practice 2003; 1st edition Pune; pg – 9.
2. Swami Satyananda Saraswati: Asana Pranayama Mudra Bandha 1996; 3rd edition Bihar; pg – 363.
3. Upadhyay Dhungel K, Malhotra V, Sarkar D, Prajapati R. Effect of alternate nostril breathing exercise on cardiorespiratory functions. Nepal Medical College Journal. 10(1), 25-27, 2008
4. Makarand Madhukar Gore: Anatomy and Physiology of yogic practices 2008; 4th edition Delhi, pg: 169 -185
5. Swami Sathyananda Saraswati: Yoga for children 2006; pg: 264-265. 450, 379 -385.
6. Galantino, Mary Lou PT, Galbavy, Robyn PT, Quinn, Lauren. Therapeutic Effects of Yoga for Children: A Systematic Review of the Literature. Pediatric Physical Therapy. 20(1), 66-80, 2008 .
7. Pande A H. Prediction of peak expiratory flow rate from height and weight. Indian Journal of Pediatrics. 53(4), 521-523, 1986.
8. Luis M, Rivera, Gordon L. Snider. Peak Expiratory Flow Rate in Normal and Abnormal Preschool Children. Pediatrics. 30 (1), 117-124, 1962
9. D. Milner A D, Ingram D . Peak Expiratory Flow Rates in Children Under 5 Years of Age. Archives of Disease in Childhood. 45(244), 780–782, 1970.
10. Vijayan V K, Reetha A M, Kuppurao K V, Venkatesan P, Thilakavathy S. Pulmonary Function in Normal South Indian Children Aged 7 to 19 Years. Indian Journal of Chest Diseases and Allied Sciences. 42,147-156,2000
11. Howard Eigen, Harvey Bieler, Debra Grant, Kathy Christoph, Delana Terrill, Douglas K. Heilman, Walter T. Ambrosius, Robert S. Tepper. Spirometric Pulmonary Function in Healthy

Preschool Children. American Journal of Respiratory and Critical Care Medicine. 163(3), 619-623, 2001.

12. Gaffin, Jonathan M, Shotola, Nancy Lichtenberg, Martin, Thomas R, Phipatanakul, Wanda. Clinically Useful Spirometry in Preschool-Aged Children: Evaluation of the 2007 American Thoracic Society Guidelines. Journal of Asthma. 47(7), 762-767, 2010
13. Subbalakshmi N K, Saxena S K, Urmimala, Urban J A, D'Souza. Immediate effect of 'nadi - shodhana pranayama' on some selected parameters of cardiovascular, pulmonary, and higher functions of brain. Thai Journal of Physiological Sciences. 18(2), 10-16, 2005.
14. Iraj Mohammadzadeh, Mohammad Gharagozlou, Seyed Abbass Fatemi. Normal Values of Peak Expiratory Flow Rate in Children from the Town of Babol, Iran. Iran Journal of Allergy Asthma Immunology. 5(4), 1
15. Yadav R.K Das. Effect of yogic practice on pulmonary functions in young females. Indian Journal of Physiology and Pharmacology. 4, 493-496, 2001.
16. Joshi LN, Joshi VD, and Gokhale LV. Effect of short-term 'pranayama' practice on breathing rate and ventilatory functions of lung. Indian journal of Physiology and Pharmacology.36, 105 -108, 1992.
17. Asha Yadav, Savita Singh, Singh K P. Role of pranayama breathing exercises in rehabilitation of coronary artery disease patients – a pilot study. Indian Journal of traditional knowledge. 8(3), 455-458,2009.