EFFECT OF DEEP BREATHING ON RESPIRATORY PARAMETERS IN HEALTHY YOUNG INDIVIDUALS

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ABSTRACT: Context: Breathing is the most vital function for maintenance of life. Slow and deep breathing is an integral part of Pranayama and it reduces dead space ventilation and renews air throughout the lungs. The reported beneficial effects of deep breathing as a part of either long term or short term practice of pranayama on pulmonary functions are well documented. However our knowledge about the effects of deep breathing on human respiratory parameters is poor. In the present study, we examined the relationship between exposure to deep breathing and performance on Respiratory parameters before and after the deep breathing. **Aim:** The present study was done to evaluate the effect of deep breathing on respiratory parameters. **Settings & Design:** The present study was a comparative prospective study consisting of 30 male healthy subjects of 18-20 years age. **Materials and Methods:** This study was conducted in the Department of physiology, Adichunchanagiri institute of medical sciences, Mandya after the institutional ethical clearance and written consent from each participant. The participants were asked to perform deep breathing. The duration of the study was twelve weeks. Pre and post deep breathing respiratory functions were assessed by measuring respiratory rate, chest expansion and breath holding time. The parameters were analyzed by Student't' test and $p<0.05$ was considered the level of significance. **Results:** There was significant decrease in respiratory rate, and significant increase in chest expansion and breath holding time compared to pre deep breathing practice. **Conclusions:** This study showed beneficial effects of deep breathing on respiratory functions in normal healthy individuals.
KEYWORDS: deep breathing, respiratory rate, chest expansion, breath holding time

INTRODUCTION: In modern life, particularly in urban area, due to rapid industrialization and tremendous population growth, there is overcrowding along with increasing pollution. In this era of computer and competition, life has become very fast, human beings are unable to draw time for physical exercise and for their physical health. Due to overcrowding and increasing building constructions along with increasing pollution, fresh ventilations have been decreased. All these

gradually deteriorate the ventilatory ability or functions of human beings. These may lead to chronic respiratory diseases like bronchial asthma, chronic bronchitis, and bronchiectasis.

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 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].

DEEP BREATHING: Deep breathing is called "diaphragmatic" because it emphasizes the use of the diaphragm, the muscular sheet underlying the rib cage. When the diaphragm contracts, it pushes down on the internal organs of your abdomen, enlarging the space allotted to your thoracic cavity and causing your lungs to expand. The stronger this contraction, the more air you'll inhale.

Many of us take shallow breaths that begin and end in our chest. When stressed, the breathing becomes even more shallow and at times we even "forget to breathe" and find ourselves holding our breath. This speeds the heart rate and causes us to cheat our body of much needed oxygen, which in turn negatively affects our entire body. Just as breathing is necessary to live, breathing properly is necessary to live well. Breathing deep, cleansing breaths from the "gut" takes practice, but it will help you to remain calm in stressful situations, release painful emotions and memories and can improve our general health and sense of well being.

Bizarre as it might seem, breathing is something most people do poorly, Dennis LEWIS writes in "Free your Breath, Free your life." Improving the way you breathe may be the most basic way to tackle stress and boost your immune system. Proponents claim anyone can breathe properly by developing deep breathing techniques.

References to deep breathing have been found in Hindu Sanskrit texts from as early as the fifth century. However the fact that is such a vital component in Eastern meditation systems, such as Taoist qi gong, tai chi and pranayama yoga, suggests that the use of deep breathing in the persuit of health and enlightenment is probably much older[2].

Slow and especially deep breathing as it is in Pranayama breathing exercise, is economical because it reduces dead space ventilation. It also renews air throughout the lungs in contrast with shallow breathing which renews air only at the base of the lungs. The reported beneficial effects of deep breathing as a part of either long term or short term practice of pranayama are an improvement in ventilatory functions[3], effect on grip strength[4] and also on heart rate variability[5]. Its effects as a part of comprehensive yoga therapy intervention are well documented[6]. Even a few successive episodes of deep inhalations are known to influence the lung and airway dynamics[7]. Deep inhalations either can increase or decrease the airway resistance depending on many variables[8]. The role of deep breathing on release of surfactant and consequent change in pulmonary compliance and other lung functions has been extensively studied, both in cultured pulmonary epithelial cells[9] and in isolated and intact lungs of many different animals[9,10,11]. But whether the same type of phenomenon occurs in intact human subjects and whether that can alter any of the parameters of respiratory functions has not been studied in detail. The present study was conducted to study the effect of deep breathing exercise on Respiratory parameters.

SUBJECTS AND METHODS: Ethical clearance for the study protocol was obtained from the institute ethical committee. 30 healthy male subjects of age group 18-20 years were selected by simple random method from a group of participants.

Healthy individuals in the age group of 18-20 years with apparently no major illness were included. Subjects with history of respiratory diseases, cardiovascular diseases and diabetes were excluded from the study. We also excluded subjects with neurological disorders and those who are not able to perform respiratory function tests. Subjects who smoked, consumed alcohol, or any drugs were excluded after taking their history.

Thus the health of the subject was assessed by noting the present, past, family and personal history and also by a thorough general and systemic examination.

The subjects were explained about the importance and procedure of the study. An informed consent was obtained from all the members. The subjects were asked not to change their life style during the period of study and were instructed not to perform any other physical exercises if they were not doing the same regularly.

All the data was collected from 5pm to 6pm. Data on physical characteristics such as age, height, weight and body mass index (BMI) was obtained. BMI was calculated as weight(kg) /height(m)2.

The study involved noninvasive procedures with no financial burden on the subjects. The subjects were informed about the procedures in brief and were asked to relax physically and mentally for 30 minutes in supine position in a silent room.

The respiratory rate, chest expansion, and breath holding time were measured for assessing respiratory functions in standing posture.

Measurement of chest expansion during deep inspiration after deep expiration was done using a measuring tape at the level of the fourth intercostal space. Three such readings were taken at an interval of 5 minutes and the maximum reading was noted in centimeters.

Breath holding time was measured in seconds from the time of holding breath after deep inspiration till the breaking point of the held breath by using a stop watch. The maximum value of three trials at 5 minutes interval was noted.

RESULTS: In the present study, the effect of deep breathing on respiratory rate, chest expansion and breath holding time was compared before and after deep breathing.

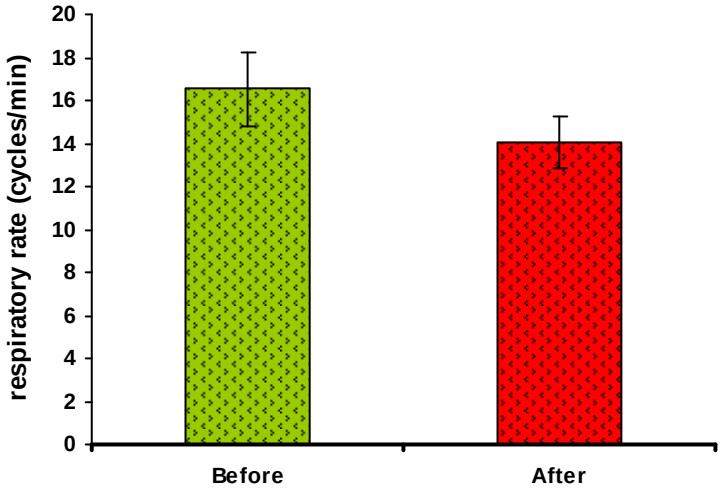
TABLE - 1

	Before (Mean±S.D)	After (Mean±S.D)	't' value	'P' value
Respiratory rate (cycles/min),	16.55±1.72	14.03±1.18	9.857	<0.001**
Chest expansion (in cm)	5.60±0.81	8.46±1.27	19.154	<0.001**
Breath holding (in sec)	48.30±4.92	53.57±5.70	8.686	<0.001**

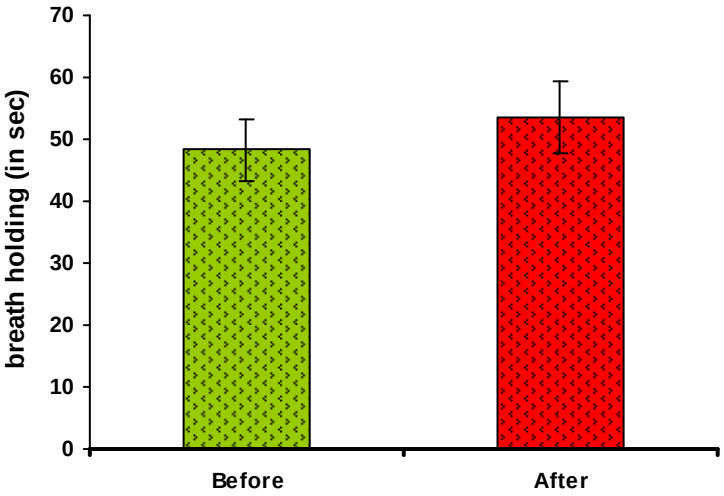
Student't' test

ANTHROPOMETRIC MEASUREMENTS: The participants recruited were almost of the same height, weight and age without exhibiting a statistically significant difference.

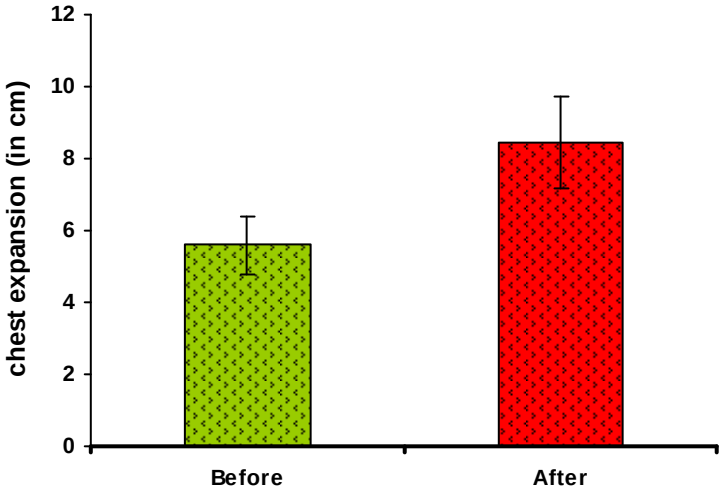
RESPIRATORY RATE; The percentage change in the respiratory rate in young healthy study groups was found to be significantly decreased when compared before and after deep breathing. (Table – 1)



BREATH HOLDING TIME (IN SEC): The percentage change in the breath holding time in young healthy study groups was found to be significantly increased when compared before and after deep breathing. (Table - 1)



CHEST EXPANSION: The percentage change in the chest expansion in young healthy study groups was found to be significantly increased when compared before and after deep breathing. (Table -1)



DISCUSSION: The ancient science of yoga makes use of voluntary regulation of breathing to make respiration rhythmic and to calm the mind to reach the ultimate goal[12]. The practice of deep breathing as a integral part of pranayama is an art of controlling the breath. Here the practitioner not only tries to breath but at the same time tries to keep his attention on the act of breathing, leading to concentration removes his attention from worldly worries and "de-stress" him. This may decrease release of adrenaline i.e., decrease sympathetic activity and hence decrease in respiratory rate, heart rate, blood pressure etc[13].

Usually breathing is not a conscious event and is regulated automatically by the nervous system through the respiratory centers located in the medulla oblongata and pons. These are the dorsal and ventral group of neurons located in the medulla, the pneumotaxic center and the apneustic center located in the pons. The activity of these respiratory centers is in turn modified by supra-pontine influences, in the conscious being. While the basic respiratory rhythm in normal situations is maintained by the impulses discharged by the dorsal group of neurons, the pneumotaxic center indirectly controls the duration of inspiration and helps in relying the suprapontine impulses which promote voluntary inspiration and expiration[3]. We believe that during daily practice of pranayama the basic activity of the bulbo-pontine complex is modified in such a wayas to slow down its rhythm. Thus after continuous practice of deep breathing for few weeks, the bulbo-pontine complex is adjusted to the new pattern of breathing which is slower than its basal rhythm. Also by voluntarily prolonging the phase of inspiration and expiration, the respiratory muscles are stretched to their full extent and the respiratory apparatus is able to work to their maximal capacity represented by increased chest wall expansion and lung volumes[14].

The significant increase in BHT in the present study is consistent with previous studies[3,15,16]. In normal breathing after a particular degree of stretching or even before this, stretch receptors in alveoli are stimulated and send information to the respiratory centers so that exhalation sets in. But in deep breathing as an integral part of pranayama there is continuation of the phase of inhalation with strong voluntary control so that lungs are expanded considerably and the walls of the alveoli are stretched to the maximum extent. Thus the chest continues to get expanded under cortical control. The stretch receptors are thus trained to withstand more and more stretching. This helps in holding

the breath for a longer time. As the duration of breath holding during deep breathing is gradually increased by practice, the respiratory center is acclimatized to withstand higher and higher carbon dioxide concentrations in the alveoli and blood. Also the subject keeps his voluntary muscles relaxed and immobile while at the same time exercising a close and continuous voluntary control over respiratory muscles, thus consciously and persistently over-riding the usual excitatory stimuli to respiratory centers. Also the receptors get acclimatized to the increased concentrations of carbon dioxide gradually by regular practice of deep breathing as an integral part of pranayama[17].

Due to proper working of these organs, vital energy flows to maintain the normal homeostasis of the body and thus it helps for prevention, control and rehabilitation of many respiratory diseases. The review on yoga showed that yoga had beneficial effect on Body Weight, Blood Pressure, Blood Glucose level and Cholesterol level[18]. The Practice of yoga was associated with significant decrease in cholesterol among subjects with cardiovascular diseases, angina, atherosclerosis, hypertension and Type 2 Diabetes at different duration of yoga[18-23].

Slow paced breathing has been shown to be effective in reducing the effects of the sympathetic nervous system by promoting the parasympathetic nervous system which has profound effects on hypertension[24-30]. The basic mechanism of action is based on the baroreflex sensitivity which reduces blood vessel sympathetic tone (vasoconstriction) after deep slow breathing[26, 27, 31].

It is thought that eventual slow breathing training to 0.1 Hertz (1 breath every 10 seconds) can actually enhance baroreflex sensitivity in humans and improve one's blood pressure profile[31]. A recent study was conducted to determine if device-guided breathing exercises have an antihypertensive effect in environments consistent with situations closer to daily life (in the home and office) [32].

In our study we found that the respiratory rate after deep breathing in young healthy subjects is significantly decreased. The increase in breath holding time did show statistically significant changes after deep breathing. These results are in line with the findings of Krogh and Lindhard[21], which might be the result of impulses from cerebral cortex influencing the respiratory centre.

Furthermore, pranayama is a useful tool for physiotherapists in cardiac and respiratory clinics. The practice of slow, deep breathing is ideally suited to help post-operative patients open their airways and speed up recovery; it also helps to stop them from getting atelactasis. Other uses include the following: stopping bed-bound patients from chest infections recover more quickly; improve breathing technique and stamina for patients in cardiac rehabilitation, build exercise tolerance in COPD patients, reduce stress and improve breathing in asthmatics and help reduce stress for patients in cardiac rehabilitation, build exercise tolerance in COPD patients, reduce stress and improve breathing in asthmatics; and help reduce anxiety and stress in the hospital environment.

CONCLUSION: Considering the findings of our study, deep breathing even for a few minutes duration seems to be beneficial for respiratory lung functions and therapeutic exercise programs for sedentary young adults can be best designed to delay the onset of fatigue and improve the mechanical efficiency of lung-Thoracic system. Further studies are needed to confirm the possible mechanism(s) for such an effect.

LIMITATIONS OF THE STUDY: The limitations of the present study are reduced population and lack of measurement of other respiratory function parameters

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