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EFFECT OF SELECTED BREATHING TECHNIQUES ON RESPIRATORY RATE AND BREATH HOLDING TIME IN HEALTHY ADULTS

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ABSTRACT: Background and Objective: Rapid industrialization, environmental pollution and overcrowding gradually deteriorate the ventilatory ability or functions of human beings. This requires special and specific breathing techniques to transcend the limits of our physical and mental abilities experienced in everyday life. Hence, in the present study, the beneficial effect of pranayama with reference to respiratory rate and breath holding time was studied. **Materials and methods:** This study was conducted in the department of Physiology, Seth G.S. Medical College and K.E.M. Hospital, Mumbai after the institutional ethical clearance and written consent from each participant. The participants were divided into control and study groups with 45 members each of both the sexes at the age group of 20±2 years. The study group was asked to perform Kapalbhati, Anulom Vilom, Bhramari and Udgeeth pranayama. The duration of the study was eight weeks. The respiratory rate and breath holding time in both the groups were recorded and analysed for statistical significance using students 't' test and $p<0.05$ was considered the level of significance.

Result: In study group, the respiratory rate was decreased significantltly ($p=0.000$) whereas the breath holding time was increased significantly ($p=0.000$) when compared to that of control group.

Discussion and Conclusion: Pranayama increases the overall capacity of lungs and gradually improves the ventilatory functioning of lungs. 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.

Key words: Respiratory rate, Breath Holding Time, Kapalbhati, Anulom Vilom, Bhramari and Udgeeth

INTRODUCTION

In modern life, particularly in urban area, due to rapid industrialization and tremendous population growth, there is an 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 of life 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 everyday 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 or 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.

Pranayama (breathing exercise) is known to be a part of yogic techniques. Patanjali in his Yoga Sutra describes- *Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana and Samadhi* as eight *angas* (parts) of yoga[3]. Amongst them, in the present materialistic world, the third and fourth part, *Pranayama* and *Asana* (Postures) are considered as very important part and prescribed by modern medicine too. 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[4]. The beneficial effects of different Pranayama are well reported and have sound scientific basis[5-7]. It was reported different types of *Pranayama* (breathing exercises) produce different physiological responses in normal young volunteers[6, 8].

Though several studies reports the pulmonary functions after pranayama, there was a scarcity of well studied reports on people living in crowded and polluted metropolitan cities. Hence, in the present study, we made an attempt to find out any beneficial effects of pranayama in those subjects with reference to respiratory rate and breath holding time.

MATERIALS AND METHODS

This study was conducted in the department of Physiology, Seth G.S. Medical College and K.E.M. Hospital, Mumbai after the institutional ethical clearance. The participants of the study were medical students of age group 18 to 22 years (20±2 years) of both the sexes, after the informed and written consent from all the participants. The duration of the study was eight weeks. Medical students who do not have any acute illness like upper respiratory tract infection, lower respiratory tract infection, gastroenteritis, smoking etc. with normal cardio-respiratory function and those who had not undergone any major surgery was included in the study. Those participants who were doing any other physical exercises, having cardio respiratory problems such as valvular heart disease, asthma, acute illnesses such as upper respiratory tract infection, gastroenteritis, Smokers etc. were excluded from the study.

Stadiometer for measuring height, Weighing Scale for measuring weight, Stop watch for measuring breath holding time and computerized Pulmonary Function test machine manufactured by MEDGRAFICS (CPFS/D USB MedGraphics preVent™ Pneumotach) was used in the present study. The recruited participants were divided into study group and control group with 45 students each of both the sexes at an age group of 20±2 years. Respiratory rate was measured in all the participants using computerized pulmonary testing machine and breath holding time using stopwatch. Each individual from the study group was explained about the procedure of pranayama (Kapalbhati pranayama, Anulom Vilom pranayama, Bhramari pranayama and Udgeeth pranayama) in detail and sufficient trials were given for proper understanding. Pranayama was practiced by the subjects of study group for a period of 8 weeks regularly, Monday through Saturday under our direct supervision. At the end of 8 weeks, Respiratory rate and breath holding time was measured in supine position.

The various breathing techniques we adopted are,

Kapalbhati pranayama: Sit in comfortable crossed leg position with back straight, hands resting on knees in dhyana, jnana, shoonya, prana mudra. Face to be relaxed, inhale deeply through both nostril expanding abdomen and exhale with the forceful contraction of abdominal muscles (pull the abdomen in by quickly contracting the abdominal muscles and exhale through the nose).

The air is pushed out of lungs primarily by contraction of the diaphragm and secondarily by contraction of all the expiratory muscles. After exhalation inhalation is passive and lungs will be automatically expanded and filled with air. One can begin with 15 respirations. After completing 15 cycles of exhalation and passive inhalation inhale and exhale deeply and take rest pause of about 15 to 20 seconds[9].
Anulom Vilom pranayama: Close the right nostril with thumb, take breathe in from left nostril. Then, open right nostril and close left nostril with middle and ring finger and breathe out from right nostril. Then, breathe in from right nostril, close right nostril and open left and breathe out from left nostril9.

Bhramari pranayama: Close ears with thumb, index finger on forehead and rest three on base of nose touching eyes. Breathe in and now breathe out through nose while humming "OM" like a bee[9].

Udgeeth pranayama: Sit in comfortable position, close the eyes, and take deep breath and release the air through mouth slowly that sound of "OM" is pronounced[9].

All the breathing techniques were performed for 10 minutes daily.

Statistical Analysis: Percentage change in respiratory rate and breath holding time before and after pranayama was calculated and analyzed for statistical significance using paired't' test. $p<0.05$ was considered the level of significance.

RESULTS

In the present study, the effect of pranayama on respiratory rate and breath holding time in healthy individuals was compared with that of individuals without performing pranayama.

Anthropometric measurements:

The participants recruited for the control and study group were almost of the same height, weight and age without exhibiting a statistically significant difference (Fig-1).

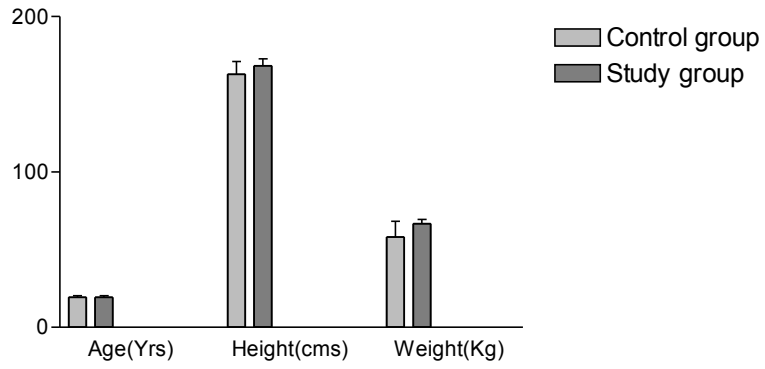

Fig-1: Anthropometric measurements of the control and study groups. N=45 in each group.

Respiratory Rate

The Percentage change in the Respiratory Rate in Young healthy study groups was found to be significantly decreased ($p=0.000$) when compared before and after pranayama. Whereas, a nonsignificant increase ($p= 0.433$) was observed when respiratory rate was measured before and after the experimental duration in control subjects (Table-1). This indicates that there was a significant decrease in Respiratory Rate after pranayama in young healthy subjects in study group as compared to that of control group.

Table-1: Respiratory rate in control at the beginning and end of the experimental procedure and in study group before and after pranayama. Values are expressed as Mean± Standard Deviation. N=45 in each group.

Respiratory Rate/ minute						
	Control group			Study group		
	Beginning of experiment	After 8 weeks	Percentage increase	Before Pranayama	After Pranayama	Percentage decrease
RR	14.77±1.85	14.93±1.62	1.71%	15.10±1.09	10.33±0.95	31.58%
t-value	-0.796			25.945		
95% CI	-0.595 to 0.262			4.391to 5.142		
p-value	0.433 (NS)			0.000 (HS)		

Note: RR=Respiratory rate/minute, CI=Class Interval, NS=Non Significant, HS=Highly Significant.

Breath holding time

The Percentage change in the Breath holding time in Young healthy study groups was found to be significantly increased (p=0.000) when compared before and after pranayama. Whereas, a nonsignificant decline (p= 0.708) was observed when Breath holding time was measured before and after the experimental duration in control subjects (Table-2). This indicates that there was a significant increase in Breath holding time after pranayama in young healthy subjects in study group as compared to that of control group.

Table-2: Breath Holding Time in control at the beginning and end of the experimental procedure and in study group before and after pranayama. Values are expressed as Mean± Standard Deviation. N=45 in each group.

Breath Holding Time in seconds						
	Control group			Study group		
	Beginning of experiment	After 8 weeks	Percentage decrease	Before Pranayama	After Pranayama	Percentage increase
BHT	48.77±9.55	48.57±8.84	0.20%	47.80±7.41	64.47±8.13	25.85%
t-value	0.379			-25.743		
95% CI	-0.880 to -1.280			-17.991 to -15.343		
p-value	0.708 (NS)			0.000 (HS)		

Note: BHT= Breath Holding Time, CI=Class Interval, NS=Non Significant, HS=Highly Significant.

DISCUSSION

Patanjali, first proponent of yoga, described *Pranayama* as the gradual unforced cessation of breathing[10]. The ancient science of yoga makes use of voluntary regulation of the breathing to make respiration rhythmic and to calm the mind to reach the ultimate goal[11]. This practice of *Pranayama* is an art of controlling the breath. A practitioner of *Pranayama* not only tries to breath but at the same time tries to keep his attention on the act of breathing, leading to concentration. This act of concentration removes his attention from worldly worries and "de-stress" him. This may decrease release adrenaline i.e. decrease sympathetic activity and hence decrease in heart rate, respiratory rate, blood pressure etc[12].

During pranayama, deep inhalation (purak) stimulates the respiratory system and fills the lungs with fresh air, retention of air (kumbhaka) raises the internal temperature and plays an important role in increasing the absorption of oxygen, slow exhalation (rechak) causes the diaphragm to return to original position and air full of toxins and impurities is forced out by contractions of intercostal muscles. These are the main components of pranayama which massage the abdominal muscles and tone up the working of respiratory organs of body. This deep inspiration, retention of air and slow expiration increases the overall capacity of lungs and gradually improves the ventilatory functioning of lungs.

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[13]. 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 [13-19]. In our study, we found that the Respiratory Rate after pranayama in Young healthy subjects in study group has decreased significantly as compared to the control group. The increase in breath holding time did show statistically significant changes after pranayama. These results are in line with the findings of Krogh and Lindhard[20], which might be the result of impulses from cerebral cortex influencing the respiratory centre.

Conclusion: Considering the findings of our study, therapeutic exercise programs for sedentary young adults can be best designed to delay the onset of fatigue and improve the mechanical efficiency of Lug- Thoracic System.

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