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RESEARCH ARTICLE

EFFECT OF MODIFIED SLOW BREATHING EXERCISE ON PULMONARY FUNCTION IN HEALTHY, ADULT MALES-AN INTERVENTIONAL STUDY

Sunil Naik G.[1], Pal G.K.[2], Satish P. Dipankar[3] and Gaur G.S[4]

1. Assistant Professor, Dept. of Physiology, AIIMS Mangalagiri.
2. Senior Professor, Dept. of Physiology, JIPMER.
3. Additional Professor, Dept.of Physiology, AIIMS Mangalagiri.
4. Senior Professor, Dept. of Physiology, JIPMER.

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Abstract

Different types of breathing exercise have varied effects on pulmonary function parameters in an individual. To study the effect of a modified Slow breathing exercise on pulmonary function parameters in adult Males.

Settings and Design: This was a randomized control, interventional study carried out at Advanced Centre for Yoga Therapy Education and Research (ACYTER), Department of Physiology, Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry.

Materials and Methods: Hundred healthy, male volunteers were recruited and randomized into control group, n=50 and Modified Slow breathing exercise(study), n=50. Modified Slow breathing exercise training was given to the study group for 30 minutes a day, 5 times/week for a total period of 12 weeks, under supervision of certified yoga trainers. Forced vital capacity (FVC), Forced end expiratory volume at the end of 1 sec (FEV_1), FEV_1/FVC ratio, Peak expiratory flow rate (PEFR), Forced expiratory flow 25-75% (FEF_{25-75}) were recorded at baseline and after 12 weeks. No intervention was given for control group. Statistical analysis was done using appropriate analytical methods by SPSS software ver.19.0.

Results: FVC, FEV_1, FVC/FEV_1, PEFR, FEF_{25-75} decreased significantly ($P<0.05$) in the study group following 12 weeks of modified Anuloma Viloma pranayama. No significant change was observed in the control group.

Conclusion: Twelve weeks of modified Slow breathing exercise significantly improved the pulmonary function parameters. This indicates that our modified alternate nostril breathing exercise is equally effective in improving the pulmonary function parameters.

Introduction:-

Pranayama isan essential component of yoga which has been practiced since ancient times in India to promotebalance in the physical, mental, and spiritual wellbeing of an individual[1,2]. Pranayama, the fourth limb of

Corresponding Author:- Sunil Naik G.
Address:- Assistant Professor, Dept. of Physiology, AIIMS Mangalagiri.

Ashtanga yogameans the regulation of universal cosmic energy through breathing.Patanjali defined pranayama as "Regulation of the incoming and outgoing flow of breath with retention" and conscious control of breath results in calmness, inner serenity, and mental clarity[1].

The awareness about pranayama has grown significantly among the scientific community and the general public in recent times[3]. Different types of pranayama, ranging from single nostril breathing to alternate nostril breathing exist. Pranayama also can be practiced slowly or rapidly and with or without breathholding [4]. The physiological effects produced differ based on the duration, pace, and incorporation of breath holding in both healthy and diseased subjects[5–7]. The effects of pranayama on cardiac and pulmonary functions also differ based on the type of pranayama practiced[8].

Slow and deep breathing is preferred to rapid and shallow breathing as it reduces the dead space ventilation. Slow, deep breathing replenishes air throughout the lung compared to shallow breathing which ventilates only the base of the lung[9]. Alternate nostril breathing improves physical and mental health by tilting the sympatho-vagal balance in favor of the parasympathetic system[10,11].

Few studies have failed to find any improvement in lung function whereas other research studies have demonstrated a significant improvement in the pulmonary function parameters after the practice of pranayama[12]. Slow deep breathing exercise when practiced along with kumbhaka(breath holding) increases the vitality and enhances the benefit of pranayama when practiced in isolation without retention of breath.

Conventional Anuloma Viloma pranayama incorporates slow, deep breathing in the form of inhalation, breath holding, and exhalation in the ratio 1:4:2, which may not be suitable for beginners. Breath holding needs to be practiced by amateurs under the supervision of a trainer and the duration of breath retention depends on the expertise of the practitioner. The prolonged breath holding associated with conventional methods is a bottle neck in the practice of pranayama by beginners and improper practice of kumbhaka could lead to undesirable effects. In conventional anulomaviloma pranayama, the increased duration of kumbhak carries an inherent risk of cerebral hypoperfusion. Samvritti pranayama which involves equal phases of inhalation, exhalation, and breath retention is a simple technique recommended for beginners and persons with "Vata" imbalance[13].

The modified form of Anuloma viloma pranayama [slow deep breathing] was standardized by Pal.et al[7], with equal phases of inspiration, breath holding, and expiration (1:1:1 ratio). We wanted to study the effect of our Modified slow breathing exercise on pulmonary function parameters in healthy adult male volunteers.

Methodology:-

After obtaining approval from the Institute Scientific Advisory Committee and Human Ethics Committee, we recruited a total of 100 healthy volunteers in the age group of 18–30 years. We excluded individuals with a history of chronic respiratory disorder, deviated nasal septum (DNS), and sinusitis along with diabetics, hypertensives, smokers, alcoholics, coronary artery disease, athletes and those already practicing any method of pranayama from the study.

We equally divided the subjects into control and study groups using a simple randomization technique (random numbers generated using computer software). The control group did not undergo any form of breathing exercise. The study group underwent our modified Slow breathingbreathing exercise for 12 weeks. One subject opted out of the slow breathing group for personal reasons in the middle of the study. At the end of 12 weeks, there were 49 volunteers in the study group and 50 volunteers in the control group.

We recorded the baseline parameters in both the groups before the start of slow breathing exercise training. We advised the subjects in study group to come at least one hour after light breakfast preferably in a light clothing. We instructed them not to perform any intensive exercise and avoid the intake of hot or cold beverage, 30 minutes prior to the recording of parameters. We recorded the Anthropometric parameters [Height, Weight, BMI] and Pulmonary function parameters [Forced Vital Capacity (FVC), Forced Expiratory Volume in first second (FEV1), FEV1/ FVC ratio, Peak Expiratory Flow Rate (PEFR) and Forced Expiratory Flow at 25-75 percentage of expiratory flow volume (FEF25-75) using MIR Spirolab III spirometer, following the ATS/ERS criteria for acceptability and reproducibility with the subject in sitting position [7]. A demonstration of the procedure was given before performing the test.

Anuloma viloma pranayama is a form of slow, rhythmic, alternate nostril breathing. Traditional Anuloma viloma consists of inhalation, kumbhaka, and exhalation in the ratio of 1:4:2. Our Slow deep breathing exercise is a modified version of the Anuloma Viloma pranayama in the ratio of 1:1:1, which was standardized by Pal et al.

The study group performed modified slow breathing exercise training under the guidance and supervision of a certified and trained yoga instructor at the Advanced Centre for Yoga Therapy Education and Research (ACYTER), JIPMER. It was ensured that there was no nasal obstruction before the start of breathing. Practice sessions were conducted five days a week in the morning and the subjects were motivated to practice the last 2 days at their residence. Pranayama training was given for a total duration of 12 weeks. Attendance register was maintained for yoga training sessions, and the data were obtained only from subjects whose attendance was at least 80 %.

The technique of Modified Anuloma Viloma:
The right nostril is blocked with the right thumb, and air is breathed in through the left nostril slowly for a count of six seconds. Then, with the help of right index finger, the left nostril is also blocked (both nostrils closed), and the breath is held for a count of six seconds. Now the right thumb is released from the right nostril, and air is breathed out for a count of six seconds. Air is breathed in again for a count of six seconds through the right nostril followed by breath holding for six seconds and finally breathing out through the left nostril for six seconds, thus completing one cycle (Figure 1).

The total time for one cycle is 36 s and each cycle is repeated for 30 minutes with a rest of five minutes in between. The breath count duration was maintained with the help of a metronome. All the parameters were again recorded after 12 weeks of practice of modified slow breathing exercise, and statistical analysis of the obtained data was performed.

Statistical analysis
Data was summarized using descriptive statistics such as mean and Standard deviation. The normality of the continuous data was tested by Shapiro-wilk test. The comparison of pulmonary function parameters between the control and study group was done by unpaired t-test. The intra-group comparison of pulmonary function parameters was done by paired t-test.

Results:-

The baseline pulmonary function parameters of the control group and study group were comparable with statistically no significant difference (Table 1). The study group showed a significant improvement in the pulmonary function parameters FVC, FEV1, FEV1/FVC, PEFR, and FEF25-75 after 12 weeks of modified Slow breathing exercise(Table 2). The control group which did not receive any intervention, showed no significant change after 12 weeks when compared with the values at baseline (Table 2).

Discussion:-

After 12 weeks of practice of modified anulomaviloma pranayama, there was a significant improvement in FVC, FEV1, FEV1/ FVC, PEFR, and FEF25-75, whereas no significant changes were observed in the control group. Our results comply with the previous studies that have reported an increase in FVC and FEV1 after practicing pranayama for a minimum of four weeks [14–17].

The enhanced strength of respiratory muscles, the clearing of respiratory secretions, and the cooperative action of the diaphragm and abdominal muscles for a thorough and effective filling of the lungs are all responsible for the improvement in lung function parameters that follow slow, deep breathing [18]. Additionally, a rise in thoracic-pulmonary compliance and bronchodilation brought on by slow, deep breathing exercise may account for the improvement in PFT values.

Following lung expansion above tidal volume and pulmonary stretch receptor activation, there is reflex relaxation of the smooth muscles of the larynx and tracheobronchial tree. This reflex relaxation lowers airway resistance and modifies the caliber of the airways [19], which accounts for the higher PEFR in our study.

Our breath is the bridge that connects our mind and body, and pranayama is a tool to help us manipulate that bridge. The variable duration of the breath cycles in pranayama are thought to be the cause of its varied physiological and

psychological benefits. It relies on the tidal capacity of that specific person in addition to the degree of participation of the mouth, nostrils, laryngeal muscle constriction, and glottis location [20].

A slow, deep breathing induces the slow-adapting stretch receptors (SAR) to be activated, leading to inhibition of the dorsal motor neuron of the vagus and the nucleus ambigus by Hering-Breuer's inflation reflex. When the inhalation volume exceeds the tidal volume, the slow-adapting receptors are activated, causing hyperpolarising, inhibitory signals to become more frequent, resulting in neural tissue synchronization. Slow, deep breathing causes parasympathetic dominance following this synchronization. As a result of pulmonary inflation, stretch receptors are activated, causing changes in the heart rate, peripheral vascular resistance, breathing pattern, and smooth muscle tone of the respiratory system.

There is an anatomical asymmetry in the respiratory, circulatory, and central nervous systems. These systems are interdependent. The unequal coupling between these systems, is caused by this anatomical asymmetry. It is believed that slow pranayama achieves equilibrium by implementing a homeostatic effect on these asymmetric forces [21]. Pranayama raises lung compliance by stimulating the secretion of prostaglandins and lung surfactant into the alveolar gaps [17]. The decrease in viscous and elastic resistance of the lungs may also contribute to the improvement in respiratory muscle efficiency and lung compliance that occurs after pranayama practice [22].

Conclusion:-

Our results indicate the benefit of simplified, uniform ratio, alternate nostril and slow breathing exercise in improving the pulmonary function parameters and the results are comparable to that of traditional Anuloma Viloma pranayama.Prolonged breath holding time which may be unsuitable for beginners and the difficulty in remembering the different ratios in conventional Anuloma Viloma pranayama can be overcome by our modified, Slow breathing exercise with equal ratios.

Fig. 1:-

Table 1:- Effect of 12 weeks of Modified, Slow breathing exercise on pulmonary function parameters (n=49).

PFT parameters	Baseline	Post intervention
FVC (L)	4.17 ± 0.68	4.37 ± 0.59*
FEV_1 (L)	3.41 ± 0.53	3.71 ± 0.45*
FEV_1/FVC (%)	82.03 ± 7.40	85.21 ± 8.06*

PEFR (L/s)	7.96 ± 1.41	8.47 ± 1.39*
FEF_{25-75} (L/s)	3.80 ± 1.01	4.18 ± 1.07*

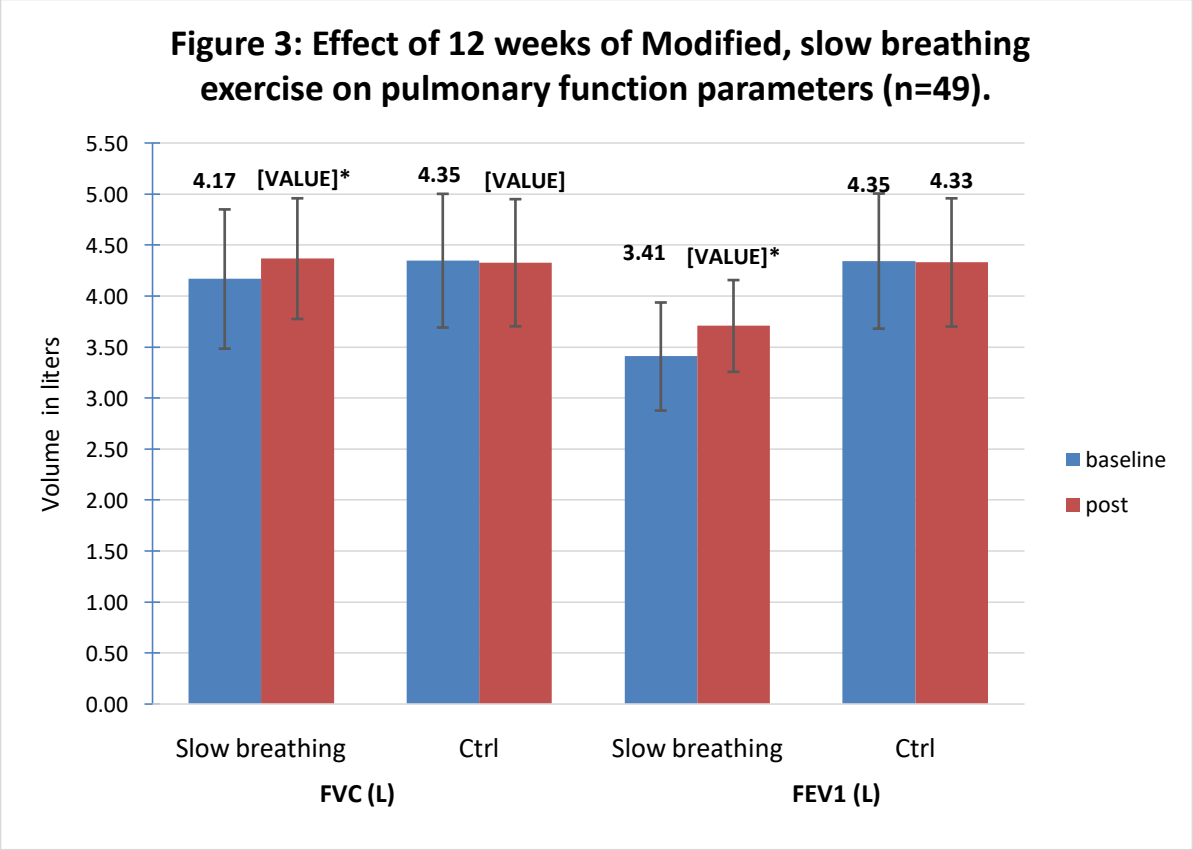
Analysis done by student's paired t-test; Values are expressed as mean ± SD; *p<0.05 (significant); FVC: Forced Vital capacity; FEV_1: Forced End expiratory Volume at the end of 1 sec; PEFR: Peak Expiratory Flow Rate; FEF_{25-75}: Forced Expiratory Flow 25-75%.

Table 2:- Comparison of baseline pulmonary function parameters between Study group (n=49) and control group (n=50).

PFT parameters	Slow breathing	Control
FVC (L)	4.17 ± 0.68	4.35 ± 0.66
FEV_1 (L)	3.41 ± 0.53	3.55 ± 0.56
FEV_1/FVC (%)	82.03 ± 7.40	81.86 ± 6.84
PEFR (L/s)	7.96 ± 1.41	7.40 ± 1.34
FEF_{25-75} (L/s)	3.80 ± 1.01	3.62 ± 0.67

Analysis done by student's unpaired t-test; Values are expressed as mean ± SD; *p<0.05 (significant); FVC: Forced Vital capacity; FEV_1: Forced End expiratory Volume at the end of 1 sec; PEFR: Peak Expiratory Flow Rate; FEF_{25-75}: Forced Expiratory Flow 25-75%.

Figure 3:- Effect of 12 weeks of Modified, slow breathing exercise on pulmonary function parameters (n=49).



*p<0.05 (significant);FVC: Forced Vital capacity;FEV_1: Forced End expiratory Volume at the end of 1s.

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