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To Study the Effect of Pranayama and Moderate Exercise on Pulmonary Functions: A Comparative Study

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Abstract: The present study was undertaken to assess the effect of Pranayama and moderate exercise on Pulmonary Functions. Two groups of 30 volunteers (age group 18-25 yrs) were selected from the undergraduate male medical students. One group of the subjects were labeled as Pranayama group and was asked to practice Pranayama. Another group of the subjects were labeled as Exercise group and were asked to perform moderate exercise. They had to do pranayama practice and exercise daily for about 20 minutes. The observations were recorded by MEDSPIROR, in the form of FVC, FEV1, PEFR, FEV1/ FVC and MVV on day -1, after 4 weeks and 8 weeks of planned intervention (pranayama or moderate exercise). There were significant increases in PFT parameters in both the group at the end of 8 weeks but results were significantly high with P value (≤ 0.05) in the Mean change $\pm$ SD was observed in the Pranayama group as compared to that of the exercise group.
Keywords: Pranayama, FVC, FEV1, PEFR, FEV1/FVC, MVV.

INTRODUCTION

Medical science tries to achieve an optimum physical and mental health of the individual through preventive, curative and promotive means. However, for a long time medical professionals have laid much emphasis on the curative aspect and only relatively recently the preventive aspect is also being emphasized whereas in yogic practice the stress is mainly on the promotive aspect, although some yogic methods are prescribed for curative purposes as well [9, 10].

A wide variety of common diseases such as coronary heart disease, hypertension and diabetes mellitus are now being attributed to a faulty lifestyle. Yoga is probably the best lifestyle ever devised in the history of mankind. It is a simple, loving, giving, non-judgmental way and view of life upon which people across culture and across countries have stumbled from time to time for centuries. This peace of universal wisdom, which has been discovered and rediscovered several times in history as the 'Ultimate Prescription for Health' peace and joy, has been organized into a systematic process in yoga [30]. After the favorable effects of a yogic lifestyle on coronary heart disease demonstrated by Dean Ornish and his colleagues, yoga is finding increasing acceptance as a non-pharmacological intervention for the prevention and treatment of several diseases [15]. The study was undertaken to assess the effect of Pranayama and moderate exercises, on pulmonary functions after 4 and 8 weeks of planned intervation.

MATERIAL AND METHODS

The present study was conducted in the Department of Physiology, SMS Medical College, and Jaipur. Two groups of 30 volunteers were selected from the undergraduate medical students of the college and their physical characteristics like height (cms), weight (kgs) and age (years) which have a role in determining the lung volumes, were measured. Healthy young compliant adults in the age range of 18 – 25 years after having taken written informed consent were included in the study. Alcoholics and smokers and subjects with a history of acute and chronic cardiopulmonary disease were excluded from the study. The One group was asked to practice pranayama. The schedule of pranayama was explained to all participants and after three days practice session, the actual practice of pranayama was introduced. Another group on moderate exercise (at a heart rate of 50-69% of maximum heart rate) [11, 29] under similar conditions of the study was part of control.

The Preparation for Pranayama

Subjects were asked to come with empty stomach and empty bladder after taking a bath early in the morning before sunrise, as per the set protocol. Subjects did pranayama in Padmasana or Sukhasana or Vajrasana in a calm and quiet environment. After the subjects had assumed the proper posture, they were instructed to close their eyes and concentrate on the sound of breathing. They were then asked to inhale slowly and deeply followed by pronunciation of 'OM' during slow and gentle exhalation. Three such pronunciation of 'OM' was performed before starting pranayama. The Pranayama schedule included four types, namely, Kapalbhati Pranayama, Bhastrika Pranayama, Anulom - Vilom Pranayama and Bhramari Pranayama. These 4 pranayamas took a total time of about 20 minutes; each of 5 minutes duration with one minute interval for rest between subsequent Pranayama. After completing the Pranayama practice, three pronunciations of 'OM' were performed as on starting the practice. Similar initial prerequisites (early morning hour, empty stomach, empty bladder, etc.) were simulated for the Exercise group who performed moderate level of exercise (Jogging with a heart rate of 50-69% of maximum heart rate) for 20 minutes under supervision. The following parameters of the pulmonary functions, Pulmonary Function Tests (PFT), were recorded using automated dry spirometer (MEDSPIROR), namely, Forced Vital Capacity (FVC), Forced Expiratory Volume in First Second (FEV_1), Peak Expiratory Flow Rate (PEFR), Forced Expiratory Volume (Timed) to Forced Vital Capacity Ratio (FEV_1/FVC) and Maximum Voluntary Ventilation (MVV).

Subjects were divided in 6 groups of 10 each. The study for each group was performed on consecutive days to restrict the evaluation load to 10 persons per day. Recording was done in both groups on Day-1, after 4 and 8 weeks of the planned intervention (Pranayama or Moderate exercise). PFT were performed 10 minutes before starting the Pranayama (or exercise) on Day-1, this initial readings served as baseline for an individual. PFT were performed again after 4 weeks and after 8 weeks, 10 minutes after completion of Pranayama (or exercise). Pulmonary function tests were performed in rested, relaxed and sitting position in the morning hours.

STATISTICAL ANALYSIS

The results of PFT are presented as Mean ± S.D. The data was analyzed by using student's paired't' test and 'z' test. P values of < 0.05 were considered significant.

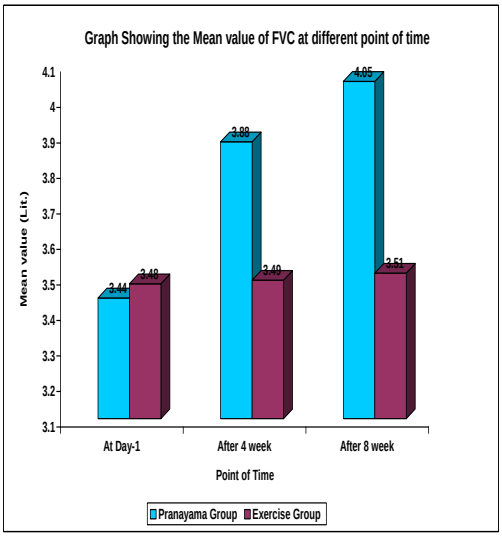
RESULTS

The results have been summarized in the given Table and graphs 1,2,3,4, and 5.The FVC, FEV_1, PEFR, FEV_1/FVC and MVV of Pranayama and Exercise group on Day1, 4th week and 8th week has been given in the table. Table exhibits the mean change ± S.D. in PFT from Day1, 4th week and 8th week of Pranayama and Exercise group. The changes observed in pranayama group in the lung functions were significantly high (excluding MVV) as compared to that seen in the Exercise group. Table shows the mean change ± S.D. in PFT from Day 1 to after 8th week of both the groups. Similar increasing trend (significantly high with P value ≤ 0.05) was observed in the pranayama group as compared to that of the exercise group.

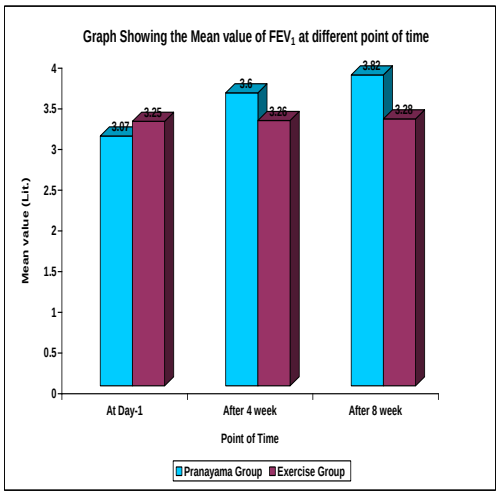
Table-1: Mean ± SD of parameters of PFT on various Day of Pranayama group & Exercise group

Variables	Groups	Day-1	4th Week	8th Week	P-1	P-2
FVC (Lit)	Pranayama	3.44±0.71	3.88±0.53	4.05±0.51	<.001	<.001
	Exercise	3.48±0.58	3.49±0.56	3.51±0.57	>.05	<.001
FEV1 (Lit)	Pranayama	3.07±0.64	3.60±0.47	3.82±0.47	<.001	<.001
	Exercise	3.25±0.54	3.26±0.47	3.28±0.53	>.05	<.001
PEFR (Lit/sec)	Pranayama	8.78±1.29	9.84±1.08	10.23±1.01	<.001	<.001
	Exercise	8.77±1.44	9.12±1.60	9.67±1.58	<.001	<.001
FEV1/FVC	Pranayama	88.93±7.12	92.47±5.40	93.97±5.37	<.001	<.001
	Exercise	92.93±6.83	93.17±6.88	93.27±6.90	>.05	<.05
MVV (Lit/min)	Pranayama	153.10±24.95	167.47±25.96	179.10±21.87	<.001	<.001
	Exercise	148.07±25.47	157.53±26.03	166.80±27.25	<.001	<.001

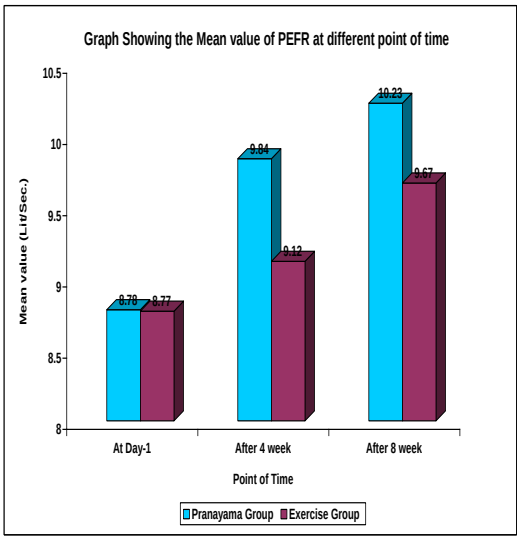
Table shows the comparison of Mean + SD of pulmonary function tests on various Day of study Group .Table exhibits Mean ± SD of Pulmonary Function Tests on Day-1, at 4th week, and at 8th week of intervention (pranayama and exercise). Forced Vital Capacity (FVC), Forced Expiratory Volume in first Second (FEV_1), Peak Expiratory Flow Rate (PEFR), Forced Expiratory Volume (Timed) to Forced Vital Capacity Ratio (FEV_1/FVC) and Maximum Voluntary Ventilation (MVV) ; p1= Day-1st vs 4th week, p2= Day-1st vs 8th week. $p<0.001$= statistical highly significance. (HS), $p<0.05$ = statistical significance. (S), $p>0.05$ = no significant differences (NS).



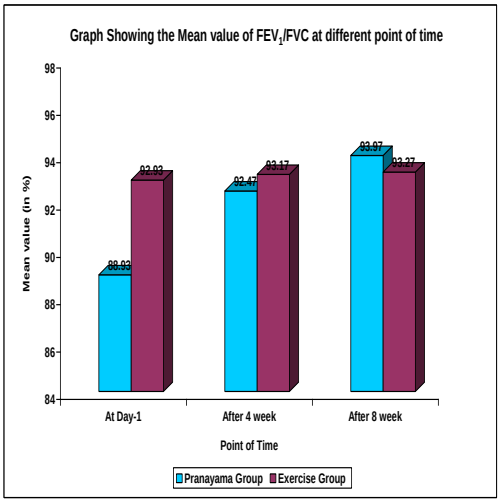
Graph-1 shows comparison of mean values of FVC in Pranayama and exercise Group on day 1,4th week, 8th week and 12th week



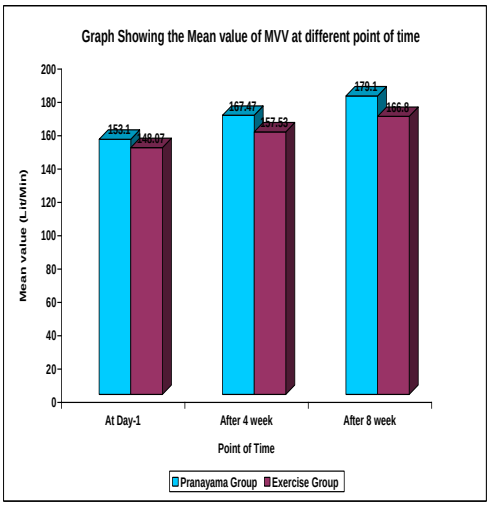
Graph-2: shows comparison of mean values of FEV 1 in Pranayama and exercise Group on day 1,4th week, 8th week and 12th week



Graph-3: shows comparison of mean values of PEFR in Pranayama and exercise Group on day 1,4th week, 8th week and 12th week



Graph-4: shows comparison of mean values of FEV 1/FVC in pranayama and exercise Group on day 1,4th week, 8th week and 12th week



Graph-5: shows comparison of mean values of MVV in Pranayama and exercise Group on day 1,4th week, 8th week and 12th week

DISCUSSION AND CONCLUSION

The present research work was undertaken to evaluate the influence of Pranayama on the variables of pulmonary functions namely, Forced Vital Capacity (FVC), Forced Expiratory Volume in first Second (FEV_1), Peak Expiratory Flow Rate (PEFR), Forced Expiratory Volume (Timed) to Forced Vital Capacity Ratio (FEV_1/FVC) and Maximum Voluntary Ventilation (MVV). The Pulmonary Function Parameters were measured with the help of MEDSPIROR at Day-1, 4 weeks and 8 weeks of post intervention (Pranayama & Exercise). Similar basal conditions were maintained for the Pranayama as well as Exercise group. The Pranayama and Exercise group had similar anthropometric profile. Lung functions improved significantly ($p < 0.001$) after 4 weeks of continuous pranayama practice where all the PFT variables increased dramatically from the baseline values at Day-1 of the study. Similar increasing trend was observed in all the parameters of PFT wherein the Mean Change ± SD so registered is more than that seen after 4 weeks of Pranayama, validating the claims of earlier studies [31] who studied the effect of yogic practice on PFT in young females and reported similar significant increase in FVC, FEV_1 and PEFR following 12 weeks of yoga practice. No significant changes could be observed at 4th week post intervention in FVC, FEV_1 and FEV_1/FVC. However, significant changes were observed in PEFR and MVV ($p < 0.001$) in the Exercise group at 4th week and all the parameters of pulmonary functions under evaluation registered a significant change after 8th week of study corroborating the earlier findings of Mehrotra *et al*. [12].

Table outlines the comparative evaluation of Mean Change ± SD in PFT parameters after 4 weeks of intervention in Pranayama and Exercise group. The changes observed in Pranayama group in the lung functions under evaluation were significantly high (excluding MVV) as compared to that seen in the Exercise group, substantiating the beneficial influence of Pranayama on lung physiology. Table also delineates

the comparative analysis of Mean Change ± SD in spirometric pulmonary functions post 8th week of intervention in both the groups. Similar increasing trend (significantly high with p value ≤ 0.05) in the Mean Change ± SD was observed in the Pranayama group as compared to that of the exercise group. The present study documented the beneficial and superlative effects of Pranayama over moderate intensity exercise on the ventilatory functions. The claims of the present study further substantiate the results of earlier research done by Nayar *et al*.[14]. Aerobic exercise (Jogging) also modulates spirometric lung functions [12]. However, enhancement in lung functions can be achieved more effectively with Pranayama as per the present study (given table and graphs 1 through 5).

The probable mechanisms by which pranayama enhances pulmonary functions greater than moderate intensity exercise and induces other beneficial effects are

- Increase in Total Lung Capacity [4] and effective emptying and filling of the respiratory apparatus more efficiently and completely [7, 21].
- Lung inflation near to total lung capacity is a major physiological stimulus for the release of lung surfactant [3] and prostaglandins into alveolar spaces [25], which increase lung compliance and decreases bronchial smooth muscle tone respectively. Yoga, with its calming effect on the mind can reduce and release emotional stresses, thereby withdrawing the broncho-constrictor effect [2, 31].
- Pranayama breathing excercises appear to alter autonomic responses to breathe holding probably by increasing vagal tone and decreasing sympathetic discharge [1], which could have therapeutic implications in situations of stress and modulate the Stress Physiology [28].
- Pranayama produces a significant decrease in oxygen consumption [7, 16, 17, 26, 27, 28], decreasing the overall reduction metabolic rate and load on the heart.
- Practice of Pranayama by regulating the oxygen intake down regulates the lipid peroxide production and increases the activity of SOD. Yogic exercises improve the free radical status, and it may also aid in checking oxidative stress induced damages. An improvement in the antioxidant status is helpful in preventing many pathological processes that are known with impaired antioxidant system of body [2, 24].
- In essential hypertension, the baroreflex sensitivity is reduced. It has been shown by Selvamurthy and his colleagues[20] that a set of selected Asanas and Pranayama return this sensitivity towards normal, thereby resetting blood pressure towards normal.
- Stress reduction and favorable effect of positive emotions on the immune response [5] possibly contribute to the beneficial results of pranayama in bronchial asthma [13]. In addition, asthma also benefits from the effects of yogic exercises on respiratory function [6, 23].
- Yoga studies have aroused a hope for the diabetics to reduce medication [18, 19] by improving the glycaemic control [9]. Pranayamic breathing makes the diabetic patients feel good [22].

Thus, practice of Pranayama seems to be beneficial for not only the respiratory system but also other systems of the body.

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