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Review

Effect of yogic exercise on respiratory system in middle aged men

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The aim of this paper is to study the effect of yogic exercise on respiratory system in middle aged men. The objective of the study is to assess respiratory parameter in both groups. For the study, we selected 90 healthy volunteers between age group 35 to 50. They were divided into 2 groups: 1) control group (45); and 2) study group (yoga) (45). Control group did not perform any exercise or yoga during 6 months period; whereas, study group performed yogic exercises and pranayama for 6 months under the supervision of yoga experts in yoga center. In both group respiratory rates, forced vital capacity (FVC) (L), forced expiratory volume (FEV_1) (L), FEV1/FEC ratio and PEFR (L/S) were recorded at 0 and 6 months period. In control group, R/R, FVC(L), FEV1(L), PEFR(L/S) , FEV1/FVC ratio showed no significant changed at 0 and 6 month period; whereas, study group (yoga) showed decreased in R/R from 17.20 ± 1.17 to 13.93±0.75 at 6 months ($p < 0.001$); FVC increased from 2.85±0.26 to 3.03±0.23 at 6 months ($p < 0.001$). FEV1 increases from 2.31±0.25 to 2.50±0.23 at 6 months ($p < 0.001$). PEFR showed significant increased from 6.62±0.77 to 7.76±0.55 at 6 months ($p < 0.001$). FEV1/FEC (ratio %) increased from 81.06±3.18 to 82.25±3 at 6 months ($p < 0.001$). Weight and body mass index (BMI) also showed significant decrease in study group ($p<0.05$). In conclusion, yogi exercises and pranayama done regularly at long term improve pulmonary function test.

Key words: Yogic exercises, pulmonary function test, respiratory rate.

INTRODUCTION

According to world health organization (WHO), the state of health is defined as a state of complete physical, mental and social well being and not merely an absence of disease or infirmity. The modern medical system has replaced all the traditional system of medicine. It has proved itself more effective in saving man from the fatal hands of contagious and infectious diseases. However, rapidly increasing incidence of stress related ailment is posing a great challenge to modern medical system. It is here that yoga appears to make a vital contribution to the modern medical system.

Yoga practices mainly stresses on promotive aspects; although, some yogic methods are prescribed for curative purpose (Anand, 1991). Yoga produces consistent physiological changes. Extensive studies on yoga claim that it increases longevity. It has therapeutic and rehabilitative effect (Bharshankar, 2003). Pulmonary function studies shows significant increase in fixed lung space (residual volume) at the expense of mobile lung space (vital capacity) with increasing age (average reduction 17.5 ml per m^2 per year in vital capacity, and increases 13 ml per m^2 per year in residual volume). The vasomotor's response to peripheral blood vessel to both heat and cold showed reduction with age (Shock, 1961).

Ageing results in progressive fall in vital capacity and maximum expiratory flow at a rate which may accelerate in more advanced year of life. In addition, there is apparent reduction in pulmonary vascular pressure and alter ventilation distribution as age progresses (Bruce, 2002). Physical activity is perhaps the most obvious variable which might reduce overall life morbidity in aged (Fries, 1973).

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Yogasana and Pranayama has beneficial effect on different system of body thereby increasing longevity, bringing equipose between psychic and somatic aspect of bodily function, helping in clearing certain diseases and thus prolonging life (Gopal, 1973). Extensive studies are available on yogic asnas and pranayama all over the world. But comparatively very few researches have been made on middle aged men.

METHODS

The present study was conducted in the Department of Physiology, Jawaharlal Nehru Medical College, Sawangi (M), Wardha on 90 male volunteers of middle aged group. A routine health examination was performed before the study was started. All the subjects were healthy and free from any health problems. The subjects were briefed about the study protocol and consent was obtained from them for the aforementioned study. The clearance (permission) of Institutional Ethical Committee of JNMC was obtained.

Selection of subject

Study group was selected from yoga centre (Anekant Swadhay Mandir, Ramnagar Wardha) and from other yoga center in Wardha city that were enrolled for yogic exercise for the first time under the supervision of yoga experts. Study group consisted of forty five volunteers of middle aged (35 to 50 years).

Control group also consisted of forty five subjects who were not practicing yoga or any other type of physical exercise and were selected from non teaching staff of Jawaharlal Nehru Medical College and also from the general population of same age group (that is, 35 to 50 years) from Wardha.

Inclusion criteria of study group

1. Men in age group of 35 to 50 years.
2. Not doing any exercise and yoga practice previously.
3. Enrolled for yogic exercise under the supervision of yoga experts for the first time.
4. Written consent obtained for participation in the study.

Inclusion criteria for control group

1. Mean in age group 35 to 50 years.
2. Not doing any exercise or yoga practice.
3. Consent to participate in the study was obtained.

Exclusion criteria for both groups

1. Previous yoga practitioner (those who practiced yoga).
2. Smokers.
3. With H/O chronic respiratory diseases or cardiovascular diseases.

Parameters

All subjects were assessed (both study group and control group) for the following parameters of respiratory system.
1. Respiratory rate/min (clinically)
2. FVC (Litre), FEV_1 (Litre), PEFR (L/sec).
3. FEV_1/FVC ratio (%) with RMS medispiror instrument.

Method

All the subjects were called to the Department of Physiology at 10 am. Routine medical examination was done. Detailed history was obtained. All the subjects were found healthy and not suffering from any illness. Name, age, and biodata of each subject were recorded and physical characteristics were determined such as weight and height. Body mass index (BMI) was then calculated. All subjects were evaluated for the respiratory parameters as mentioned earlier. Control group consisted of subjects who did not perform any physical exercise or yoga practice. Study group was trained by yogic expert (in yoga centre) in different yoga exercises and pranayam. In yoga centre, yoga classes were held early in the morning in two batches. All the subjects performed yoga for one hour daily for 6 months.

The yogic exercise

Pranayam

Pranayam is mainly breathing exercises. The carried for 3 to 5 min each. Two types of pranayam were performed.

Anuloma –Viloma: Anuloma-viloma is also called nadi shuddi pranayam. This was the first exercise the group did after understanding the exact procedure. It involves sitting in any comfortable meditative pose like padmasana, lotus pose or vajrasana (thunder belt pose) keeping the spine and neck erect. Left hand is kept on left knee and right hand thumb on right nostril. The index, fourth and middle fingers are placed on the middle of the forehead. The slow long breath is taken through the left nostril, then the left nostril is closed with the index and middle finger (which is kept on the forehead) and the air is expired from the right nostril. At the end of expiration, there is a pause and then again long and steady breath is taken through the right nostril and then right nostril is closed and air is expelled from left nostril. Such cycle repeated for 5 to 10 minutes.

Kapalbhati: With same posture as in anuloma-viloma, next exercise kapalbhati was done. Kapalbhati has two words, one is ‘kapal’ means forehead and the word ‘bhati’ means bright; which means that a person who practices kapalbhati, his face and forehead become bright.

This is a pattern of gerky, shallow, rhythmic expiration making quick abdominal movement inward at the rate of 50 to 60 per min. The inhalation is passive and automatic; there were no pause between inhalation and exhalation. This was carried for 5 to 10 min.

Posture (asanas)

Four fundamental points to be kept in mind while performing various Asanas (posture).

(a) Stability of posture
(b) Comfort
(c) Minimum possible effort
(d) Awareness and concentration

Change from one posture to other should be slow and gentle and breathing should be natural. This was carried for 35 to 45 min. After asanas, the following were performed:

Table 1. Showing distribution of cases according to age.

Sn	Age range in years	Control group		Study group		χ^2-value
		No of cases	%	No. of cases	%	
1	35-40	15	33.33	13	28.88	1.24
2	41-45	17	37.77	14	31.11	p-value = 0.53
3	46-50	13	28.90	18	40.01	Not-Significant
Total		45	00.00	45	100.00	p>0.05

(i) Tadasan
(ii) Pawanmuktasana
(iii) Bhujangasana
(iv) Vajrasana
(v) Shalbhasan
(vi) Makrasan
(vii) Shavasan

Physical characteristics

1. Age was taken to nearest year.
2. Height was measured by measuring tape to nearest cm with subject standing barefooted. Weight was taken on standard weighing machine to the nearest of kg (in light cloth and without footwear), BMI was calculated by the formula.

$$BMI = \frac{\text{Weight in kg}}{\text{Height in m}^2}$$

Respiratory parameters

Spirometry

Respiratory parameter, forced vital capacity (FVC) (L), forced expiratory volume in one second (FEV_1) (L), PEFR (l/s), FEV_1/FVC ratio (%) were taken on RMS medispiror (computerized spirometer). FVC test was done on medispiror. First, the subject was asked to sit on the chair. The procedure was explained to subject before carrying the test. They were asked to practice the procedure. After sufficient exposure to practice the volunteers were instructed to take maximum inspiration and blow into mouthpiece as rapidly, forcefully and completely as possible. It was ensured that a tight seal was maintained between lips and the mouth piece of spirometer. Each subject was given three trials and best of three was taken for study (Mohan et al., 2003).

Respiratory rate

Respiratory rate was taken clinically by inspection. Subject was asked to lie in supine position in examination table in well ventilated and well lighted examination room. Clothing from chest and abdomen was removed. Frequency of breathing was counted by observing abdominal wall movement for a full minute from foot end position. Three such reading taken at the interval of 5 min and average is taken as a final reading.

Statistical analysis

Appropriate statistical analysis was done using students t-test.

Observations

In present study, respiratory parameter such as forced vital capacity FVC (L), FEV_1 (L), PEFR (L/s), FEV_1/FVC ratio (%), respiratory rate, were studied in 90 total subjects. Ninety subjects were divided into two groups. Control group consisted of 45 healthy subjects who were non-exercising and non yogic person and study group consisted of 45 healthy yoga practitioners. Both groups were free from any illness and from the same region. All subjects ranged from 35 to 50 years of age. Age and physical characteristics such as height, weight were noted. BMI was calculated.

Table 1 shows the number of cases in five years group in control and study group. The difference is not-significant.

DISCUSSION

Ninety normal healthy male subjects with age group 35 to 50 years were selected for the study and were divided into two groups. Control group consisted of 45 subjects which were non-exercising and non yogic. Study group consisted of 45 subjects who were asked to perform yogic practices under supervision of yoga expert for six month and comparative study between both groups regarding changes in respiratory changes was carried out at 0 and 6 months interval. The present study revealed many important and significant results.

Follow up chart showing mean value and standard deviation (Tables 2 and 3) in control and study group respectively) revealed that gradual changes take place in respiratory system after 6 months of interval.

Physical characteristics

Body weight and body mass index

Tables 2 and 3 show insignificant reduction in body weight and BMI in study group; but not significant change in control group at 0 and 6 month reading.

Respiratory parameters

Respiratory rate

In the present study, Table 3 shows that respiratory rate

Table 2. Comparison of various parameters at six month interval in control group.

Parameters	1st reading (0 month)	2nd reading (6 month)	t-value	p-value
Age (years)	42.97±4.34	43.42±4.35	0.50	0.61 NS, p>0.05
Height (cm)	165.08±4.52	165.08±4.52		NA
Weight (kg)	63.40±6.20	63.73±5.70	1.85	0.07 NS, p>0.05
BMI (kg/m^2)	23.26±2.22	23.32±2.05	0.68	0.49 NS, p>0.05
Respiratory rate (per min)	16.73±1.32	16.51±0.94	1.13	0.26 NS, p>0.05
FVC (L)	2.94±0.22	2.92±0.19	1.51	0.13 NS, p>0.05
FEV_1(L)	2.38±0.19	2.34±0.17	2.76	0.008 NS, p>0.05
PEFR (L/s)	6.69±0.65	6.64±0.50	1.31	0.19 NS, p>0.05
FEV_1/FVC ratio (%)	80.62±2.48	80.21±2.36	1.75	0.08 NS, p>0.05

decreases from 17.20±1.17 to 13.93±0.75 at 6 months of yogic practices with t-value 21.17 and $p < 0.001$ which is highly significant. Whereas, for control group, non-significant changes.

Similar finding was observed by Joshi (1992), Srivastava (2005), Jain (2005) and Makwana (1988). However, Telles (1994) did not find any significant change in respiratory rate. In this study, decrease in respiratory rate in yoga group is probably due to pranayamic breathing. Breathing is not a conscious event but regulated automatically by bulbopontine respiratory control mechanism which is further modified by suprapontine mechanism in the conscious being. The pneumotaxic centre is supposed to relay suprapontine messages which promote voluntary inspiration and expiration (Wright, 1982). Due to pranayamic breathing by prolonged inspiration and expiration, bulbopontine complex is adjusted to a new pattern of breathing which is slower than basal breathing (Joshi, 1992). Decline in respiratory rate is influenced probably by hypocapnea on medullary respiratory centre and persistent voluntary breathing producing inhibition of rhythmic spontaneous breathing by a phenomenon akin to over drive suppression (Srivastava, 2005).

Forced vital capacity (FVC (litre))

In the present study, mean value of FVC (L) increases from 2.85±0.26 to 3.03±0.23 at 6 months with t-value 19.18 ($p<0.001$) which is highly significant in study group (Table 3). Whereas, Table 2 shows insignificant change in mean value of FVC (L) in control group. However, Khanam (1996) reported no significant change in FVC, FEV_1 which might be due to structural changes in lung of asthmatic patients. In the present study, increase in mean FVC (litre) in study group, probably can be explained on the following ground. There occurs strengthening of respiratory muscle due to regular practice of pranayamic breathing during which lung and chest inflate and deflate to the fullest possible extent and muscles works to the maximum extent.

Due to pranayam, diaphragm and muscles work to fullest extent which improves the lung function. Yogic exercise (as in Kapalbhati) causes powerful stroke of exhalation in quick succession with abdominal and diaphragmatic muscle used to fullest extent. The act of pranayam trains respiratory apparatus to get emptied and filled more completely and efficiently which increase vital capacity (Bhole, 1970).

Table 3. Comparison of various parameters at various time intervals in study group.

Parameters	1st reading (0 month)	2nd reading (6 month)	t-value	p-value
Age (years)	43.73±4.74	44.20 ±4.78	0.46	0.64 NS, p>0.05
Height (cm)	165.60±5.16	165.60±5.16	NA	
Weight (kg)	65.84±9.95	65.24±9.19	3.67	0.001 S, p<0.05
BMI (kg/m^2)	23.95±3.00	23.73±2.72	3.60	0.001 S, p<0.05
Respiratory rate/min	17.20±1.17	13.93±0.75	21.71	0.000 HS, p<0.001
FVC (L)	2.85±0.26	3.03±0.23	19.18	0.000 HS, p<0.001
FEV_1 (L)	2.31±0.25	2.50±0.23	21.06	0.000 HS, p<0.001
PEFR (L/s)	6.62±0.77	7.76±0.55	18.07	0.000 HS, p<0.001
FEV_1/FVC ratio (%)	81.06±3.18	82.25±3.00	5.19	0.000 HS, p<0.001

Forced expiratory volume in one second (FEV_1 (L))

In the present study, mean value of FEV_1 (L) increased from 2.31±0.25 to 2.50±0.23 at 6 months with t-value 21.06 (p<0.001); result is highly significant in study group (Table 3). Whereas, Table 2 shows insignificant change in mean value of FEV_1 (L) in control group. In the present study, increase in FEV_1 (L) probably, may be due to pranayamic breathing and yogasana which increases ventilatory function due to greater strengthening of the respiratory muscles.

FEV_1/FVC ratio (%)

In the present study, mean value of FEV_1/FVC ratio (%) increases significantly from 81.06 ± 3.18 to 82.25 ± 3.00 at 6 months showing t-value 5.19 (p<0.001, Table 3). Whereas, Table 2 shows FEV_1/FVC ratio (%) in control group, it is 80.62 ± 2.48 at 0 months, 80.21 ± 2.36 at 6 months which is not significant. Similar observation was found by Joshi (1992) in female subjects, the value increased from 95.58 to 96.91%; whereas, Makwana (1988) did not find any significant change. Yoga helps in improving this parameter as it does for other dynamic lung functions (Udupa, 1975).

Peak expiratory flow rate (PEFR (L/S)

In the present study, mean value of PEFR (L/s) increases from 6.62 ± 0.77 to 7.76 ± 0.55 at 6 months showing t-value 18.07 (p < 0.001) which is highly significant in study group (Table 3). Whereas, Table 2 shows that mean value of PEFR (L/s) in control group. Our result was also supported by other workers such as Mohan (2003), Subbalakshmi (2005), Srivastava (2005), Joshi (1992). In the present study, increase in PEFR may be due to yogic practices that increases the thoracopulmonary compliance above the basal level. Stimulation of pulmonary stretch receptors by inflation of lung, reflexly relaxes the smooth muscle of larynx and traceobhronchial tree. Probably, this modulate airway caliber and reduces airway resistance (Wrights, 2003). The increases in the respiratory parameters might be due to strengthening of the respiratory muscles due to yogic exercise. Yogic breathing exercise train the practitioner to use diaphragmatic and abdominal muscles more efficiently.

CONCLUSIONS

(i) There was significant reduction in respiratory rate in study group $p < 0.001$; while in control group changes were not significant.
(ii) A significant increase was noted in FVC (L), FEV_1 (L), PEFR (L/s), FEV_1/FVC ratio (%) in study group.

Thus, the present study reveals that yogic exercise and pranayam done regularly and for long term, improves respiratory efficiency.

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