Effects Of Yoga And Physical Exercise On Cardio-Respiratory Parameters

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Abstract : Background: Yoga includes combination of postural exercise (Asanas),Voluntary breathing exercise (pranayam) & relaxation techniques. The comparative study about effects of regular practice of yoga & physical exercise on cardio-respiratory functions and respiratory pressures (MIP,MEP) is very important to better understand it's effect on health. Method: 200 healthy volunteers (146M-54F) from age group (17 - 26)years were included in the study.They were divided in to two groups. Gr A Yoga group(n=100),Gr B Physical exercise group(n=100). Yoga group practiced some yoga exercises including Asanas,Pranayam & relaxation postures daily one hour for 3 months.While Physical exercise group practiced slow walk,calisthenic exercise & stretching exercises daily 1 hour for 3 months. Following parameters were recorded at start & end of the study. Resting cardiovascular parameters including HR,BP,PP,MAP,RPP & DoP were recorded. Pulmonary parameters (FVC,FEV1,FEV1/FVC,PEFR,MVV) were recorded. Apart from this MIP,MEP & 40mmhg endurance test were also recorded .Result: Yoga group shows significant reduction in Heart rate ($p<.01$),SBP & DBP ($p<.05$), MAP($p<.01$),while exercise group shows only decreasing trend. FVC & FEV1 inreased significantly after yoga training. FEV1/FVC, PEFR & FEF25-75% shows increasing trend in both the groups,but only exercise group shows significantly raised PEFR & FEF25-75%. MVV was significantly improved in yoga group. MIP,MEP were significantly increased after yoga training. Timing of Respiratory Endurance test was also significantly raised($p<.05$) in yoga group. Conclusion: 3 moths Yoga training produces a significant improvement in respiratory pressures (MIP,MEP), spirometric values [Choudhary R et al NJIRM 2013; 4(3) : 50-55]

KEY Words: Yoga,Physical Exercise,PFT, Respiratory Pressures.

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Introduction: Yoga is an ancient philosophic system that originated in India whose main objective is the development of the union of mind and body through exercise, respiration and meditation in order to achieve physical and mental well being.[1-2] The most popular branch of yoga is Hatha Yoga, which consists of a combination of postural exercises (Asanas), relaxation and voluntary breathing exercise (Pranayamas).

All over the world, Hatha Yoga has gained popularity as an alternative form of physical activity since it offers a different experience when compared to traditional physical exercise training and is less strenuous and more enjoyable.[3]

The comparative study of the effect of regular practice of yoga and physical exercise on cardio respiratory functions and respiratory pressures, is important to better understand its effects on healthy individuals and to provide the basis for the possible use of yoga techniques as alternative therapy.

In this respect the present study evaluated the effect of regular practice of Hatha Yoga and physical exercise on, pulmonary function tests, resting cardiovascular parameters and respiratory pressures.

Material and Method: This study was conducted on 200 healthy students and volunteers between age of 17-26 years of either sex (M146: F54) from Dr. S.N. Medical College, other academic colleges and yoga centres.

Subjects included in the study were non alcoholic, non smokers, not taking any type of medication and were having similar dietary habits.

Subjects involved in heavy physical exercise and previous experience of yoga training, history of any major medical illness and major surgery were not included in the present study.

Subjects were divided in 2 groups: the yoga group (n=100) (M78:F22)allocated to practice yoga for 3 months and the exercise group (n=100) (M68:F32)

allocated to practice physical exercise for 3 months.

The volunteers and students were briefed about the outcome of study and a written consent was obtained from them.

Yoga Group: - Yoga group was given yogic training for 1 hour under the guidance of qualified yoga instructor for 3 months regularly. The yogic schedule includes – asanas (postural exercise),pranayma (breathing exercise) and relaxation techniques.

Asanas were performed for 40 min. duration. Each subject performed every asana 3 times. The asanas were followed by a meditation/ deep relaxation technique in shavasana (corpse posture) for 5 min. & pranayama (breathing exercise) were performed in the last 15 minutes. The set of asanas & pranayama included in the course are listed in Table -1

Table: I Details Of Yogic Practices

ASANAS
(A) Standing
1. Ardhakatichakrasana (lateral arc pose) 2. Padahastasana (forward bend pose)
(B) Sitting
Ardhamatsyendrasana (half-spinal twist pose) Pschimottanasana (back stretch pose)
(C) Lying on stomach (prone)
1. Makarasana (crocodile pose) 2. Bhujangasana (cobra pose) 3. Shalabhasanas (locust pose) 4. Dhanurasana (bow pose)
(D) Lying on back (supine)
1. Utthanpadasana (straight leg raising) 2. Ardhahalasana (plough pose) 3. Pavanmuktasana (wind relieving pose) 4. Setubandhasana (bridge pose)
(E) Deep Relaxation in Shavasana (Corpse Pose)
(F) Pranayama (Breathing Practices)
1. Kapalbhati Pranayama 2. Anulom-VilomPranayama (alternate nostril breathing) 3. Bhramari (honeybee sound during expiration)

The physical exercise group: - This group was given physical exercise training for 1 hour under the guidance of physical exercise instructor. This 1 hour session was divided into 4 stages: warm up (10 min.) calisthenics (30 min.) cool down (5min.) & stretching (15 min.).

In warm up stage – subjects performed stretching & low energetic demand aerobic exercise such as slow walk & brisk walk followed by jogging & running (somewhat hard intensity). Warm up followed by calisthenics exercise – like jumping jacks, lunges, sit-ups, crunches, push-ups, squat, flutter kick, mehkik.

Cool down stage (5 min.) includes slow jogging & walking for 5 min. (to decrease body temp. / sweating).

Lastly stretching exercise was done for 15 minutes. These include- neck stretch, upper back stretch, triceps stretch, chest & biceps stretch, quadriceps stretch, calf stretch, butterfly stretch, hamstring stretch, lower back stretch, back extension stretch.

Parameters:-

First anthropometric characteristics (body weight,height,and BMI) were evaluated using an anthropometric scale.(Table-2)

Table-II Anthropometric measurements in yoga and physical exercise group

Parameter	Yoga Group		Physical Exercise Group	
	Pre	Post	Pre	Post
Height (m)	1.69± 0.07	1.69± 0.07	1.69± 0.09	1.69± 0.09
Weight (kg)	60.63± 8.91	60.29± 8.61	59.36± 5.96	58.3± 5.69
BMI (Kg/m^2)	21.24± 2.72	21.07± 2.58	20.82± 1.97	20.39± 1.91

Then before starting the training & after end of 3 months following parameters were measured.

Resting cardiovascular parameters: After 10 minutes of supine rest, right brachial systolic (SP) and diastolic (DP) blood pressure as well as heart rate (HR) were recorded using a standard mercury column sphygmomanometer and stethoscope. Pulse pressure (PP = SP - DP), mean pressure (MP = DP + PP/3), rate pressure product [RPP = (HR × SP)/100] and double product (Do P = HR × MP/100) were calculated for each recording. Three BP and HR recordings at 1-minute intervals were taken and the lowest of these values was included for the present study.

Pulmonary function tests

Forced vital capacity (FVC), forced expiratory volume in 1 st second (FEV1), and FEV1/FVC, peak expiratory flow rate (PEFR), FEF25-75% , MVV (Maximum voluntary ventilation) were measured using a computerized spirometer (Helios 401, RMS Recorders & Medicare Systems, Chandigarh). The subject was instructed to take maximum inspiration and blow into the mouthpiece as rapidly, forcefully and completely as possible. It was ensured that a tight seal was maintained between the lips and the mouthpiece of the spirometer. Minute ventilation (MV=TVxRR) Breathing Reserve(BR=MVV-MV), and Dyspnoeic Index(DI=MVV-MVx100/MVV)were calculated for each recording.

Respiratory pressures :Maximum inspiratory pressure (MIP) and Maximum expiratory pressure (MEP) were recorded as follows. MIP was determined by asking the subject to perform maximum inspiratory effort against Aneroid manometer after breathing out fully. The maximum level at which the pressure could be maintained for about 3 seconds was noted. MEP was determined by asking the subject to blow against the Aneroid manometer after taking in a full breath. MEP that could be maintained for about 3 seconds was noted. It was ensured that the subjects did not use oral muscles to develop pressure or use their tongue to block the tubing. Respiratory endurance test (40mmHg test) was also determined. It includes maximum time for which subjects can maintain 40mmHg pressure in mercury manometer.

The above-mentioned parameters were measured before and after the 3-month study period in both the groups. For each parameter, three trials at 3-minute intervals were given and highest of the three values was used for statistical analysis.

Analysis of data- Paired Student t test was used to compare the datas. P value <0.05was considered significant.

Observation and Result:

Table-3, Shows cardio-vascular changes in Yoga and Physical exercise groups.

Parameter	Yoga Group		Physical Exercise Group	
	Pre	Post	Pre	Post
Heart Rate (beats/min)	77.69 ±8.57	73.38± 5.52**	76.89± 6.89	75.48± 6.3
SBP (mmHg)	124.3 9±7.6	121.26 ±6.79*	125.83 ±8.7	123.77± 8.76
DBP (mmHg)	76.04 ±6.7	73.62± 5.3	77.5± 8.62	76.26± 6.19
MAP (mmHg)	92.16 ±5.48	89.5± 4.46**	93.61± 6.83	92.1± 5.4
Rate Pressure Product	96.69 ±12.6 5	89± 8.54**	96.74± 11.01	93.32± 9.28
Double Product	71.66 ±9.56	65.70± 6.22**	71.92± 7.97	69.43± 6.28

*P<.05 on comparing pre and post yoga group, ** P<.01 on comparing pre and post yoga group

On comparing pre and post training data's yoga group shows significant (p<0.01) reduction in resting heart rate. Although decreasing heart rate was also observed in physical exercise group but statically it was not significant.

Both the group shows reduction in systolic and diastolic blood pressure but only in yoga group significant reduction (p<0.05) in systolic blood pressure was observed.

MAP was significantly reduced (p<0.01) in post yoga group, while exercise group shows only decreasing trend (p>0.05). Yoga group also shows significant reduction (p<0.01) in RPP and DoP.

Table -4 Shows respiratory function parameters in Yoga and Physical exercise groups.

Parameter	Yoga Group		Physical Exercise Group	
	Pre	Post	Pre	Post
$FVC_{(L)}$	3.46±0.64	3.73±0.67*	3.42±0.64	3.5±0.67
$FEV1_{(L)}$	3.14±0.59	3.39±0.59*	3.1±0.59	3.21±0.63
FEV1/FVC (%)	91.08±4.87	91.1±5.26	90.64±4.3	91.62±4.2
$PEFR_{(Lt/sec)}$	7.04±1.48	7.16±1.28	7.16±1.62	7.73±1.61 £
FEF (25-75%) (L/Sec)	3.85±0.94	3.93±0.77	3.93±0.87	4.37±0.82 ££
$MVV_{(L/Min)}$	115.33±24.1	126.9±19.3**	116.3±22.3	121.7±22.3
Minute $Ventilation_{(L/Min)}$	7.43±1.31	7.51±1.26	7.71±1.55	7.71±1.20
Breathing $Reserve_{(L/Min)}$	107.90±23.8	119.46±19.2**	108.61±22.3	114.08±22.2
Dyspnoeic index(%)	93.30±1.78	93.95±1.39**	93.16±1.7	93.49±1.42

*P<.05 on comparing pre and post yoga group .
** P<.01 on comparing pre and post yoga group.
£ P<.05 on comparing pre and post exercise group
££ P<.01 on comparing pre and post exercise group.

FVC and FEV1, were increased in both the groups but yoga group shows significant appreciation (p<0.05). FEV1/FVC% was not changed significantly in both the groups.

PEFR shows increasing trend in both the groups but it was significantly increased in physical exercise group. Similar trend was also observed for FEF 25-75% , which shows significant rise in physical exercise group.

Yoga group shows significant improvement in MVV, BR, DI, after yoga (p<0.01), while appreciable rise of these parameters were also observed after exercise training but statistically it was insignificant.

Table -5 Shows changes in respiratory pressures & Endurance test in Yoga and Physical exercise groups.

Parameter	Yoga Group		Physical Exercise Group	
	Pre	Post	Pre	Post
$MEP_{(mmHg)}$	85.28±21.4	96.68±22.02**	84.6±24	91.82±23.9
$MIP_{(mmHg)}$	117.42±22.8	129.32±18.6**	121.76±19.8	126.48±20.0
40 mm Hg $Test_{(sec.)}$	34.67±9.1	42.47±9.23**	40.66±11.4	44.45±11.2

** P<.01 on comparing pre and post yoga group.

There was a significant increase in MEP and MIP in post yoga group as compared to pre yoga group while increasing trend was observed in physical exercise group (p>0.05).

Timing of respiratory Endurance test was also significantly (p<0.05) raised in post yoga group from base line data's, while in physical exercise group timing of respiratory Endurance was increased yet insignificantly (p>0.05).

Discussion: Yoga training shows significant reduction in Resting Heart Rate, Systolic Blood pressure, Mean arterial pressure, rate product and double product. (p<.01)

RPP and DOP are indirect measures of cardiac oxygen consumption and work done by the heart. In post training analysis of both Yoga and Exercise group there was a fall in cardio vascular parameters SP, DP, MAP, RPP and DOP but SP, MAP, RPP and DOP was significantly reduced in Yoga group only. This may be understood as being a result of more relaxed state of mind leading to decrease in sympathetic tone coupled with a

reduced load on heart as illustrated by RPP and DOP.

Pulmonary Functions and Respiratory Pressure : FVC & FEV1, increased significantly after yoga training is consistent with earlier studies. Bhole et al [4] have reported a significant increase in vital capacity after 3 weaks of yoga training . Brirkel & Edgren [5] found that yoga training produced a significant improvement in vital capacity across all categories of subjects that included smokers, asthmatics as well as those with no known lung disease.

In this study PEFR was increased but in significantly in both the groups. Joshi et al [6] have reported that pranayam training improves ventilatory function in form of increase in FEV, FEV1 & PEFR.

This can be attributed to the increase in the strength of major respiratory muscles following yoga training. In the present study yoga training significantly increases MIP and MEP (P<.01). This suggests that yoga training improves the strength of both expiratory & inspiratory muscles. The different postures of asanas involve isometric contraction and chest wall expansion which may be improving strength of intercostals muscles. Maximum respiratory pressures are specific indicator of respiratory muscle strength and highest MIP is obtained at lung volumes of less than 50% of total lung capacity and highest MEP is obtained at lung volumes of more than 70% of total lung capacity [7]

Earlier studies have reported improvement in the strength of inspiratory and as well as expiratory muscles following yoga training [8.] Our results of increase in MIP & MEP do not agree with those of Gopal et al[7] who have reported lower MEP in yoga training .However the present findings are consistent with earlier work of Chen & Kno[9] who have reported that inspiratory muscle endurance is greater in physically active men then sedentary men.

Respiratory pressures are specific & sensitive indices of respiratory muscle strength & they are easy to measure of reproducible. Black &Hyatt[10] have demonstrated that their values are altered before there is alteration in other commonly used pulmonary function testes. Hence evaluation of respiratory muscle strength is important from physiological as well as clinical point of view.

In our study respiratory Endurance test shows significant increase in timing after yoga training. After yoga training due to increase in strength of respiratory muscles, other parameters like maximum voluntary ventilation , breathing reserve, dyspnoeic index (MVV-MV*100) / MVV is also significantly increased.(p< 0.1) MVV is an overall test of the respiratory apparatus measuring the status of respiratory muscles, mechanical properties of lungs and chest. Specific exercise training of the ventilatory muscles improves their strength and endurance and increases both inspiratory muscle function and MVV.[11]The increase in MVV following yoga training of 3 months duration is in line with the studies done by Nayer HS [12],Bal BL[13]and Sayyed et al[14]

Our results are also consistent with the findings of other workers who have reported beneficial effects of Yoga training on pulmonary functions.
Yoga training resulted in appreciable and statistically significant improvement in most of the parameters measured in this study.

Conclusion: The present study shows that 3 months yoga training produces a significant improvement in cardiovascular parameters (HR, MAP), respiratory pressures and spirometric values, as compared to physical exercise group.

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