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Physiology

A COMPARISON ON EFFECTS OF YOGA AND PHYSICAL EXERCISE ON RESTING CARDIO-VASCULAR PARAMETERS, BREATH HOLDING TIME (BHT) & RESPIRATORY ENDURANCE TEST

Dr. Sonika Choudhary Assistant Professor, Department of Physiology, R.N.T. Medical College, Udaipur, Rajasthan, India

ABSTRACT

BACKGROUND: Health and physical fitness depend highly on cardio-respiratory efficiency of an individual. The comparative study about effects of regular practice of yoga & physical exercise on cardiovascular and respiratory functions is very important to better understand it's effect on health.

METHOD: 200 healthy volunteers (146 M; 54 F) from age group (17-26) years were included in the study. They were divided into two groups. Gr A Yoga group (n=100) practiced some yoga exercises including Asanas, Pranayam & relaxation techniques daily one hour for 3 months. While Gr B Physical exercise group (n=100) 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 resting HR, SBP, DBP, PP, MAP, RPP & DoP. Apart from this BHT & 40mmHg endurance test were also recorded.

RESULT: Yoga group showed significant reduction in heart rate ($p<0.01$), SBP ($p<.05$), MAP RPP & DoP ($p<.01$), while exercise group showed only decreasing trend. Yoga training resulted in improved respiratory functions in the form of increases in the 40 mm Hg test and prolongation of breath holding time (BHT) whereas BHT was found to be increased in exercise group after 3 months of training.

CONCLUSION: There was definite improvement of cardiorespiratory functions after 3 months of Yoga training.

KEYWORDS : Yoga, Physical Exercise, cardiovascular parameters, BHT, 40 mm Hg test.

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 on the effect of regular practice of yoga and physical exercise on resting cardiovascular parameters, breath holding time (BHT) & Respiratory Endurance test, 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.

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), relaxation techniques and pranayma (breathing exercise).

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-1 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, mule kick.

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-2 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±.07	1.69±0.09	1.69±.09
Weight (Kg)	60.63±8.91	60.29±8.61	59.36±5.96	58.3±5.69
BMI (Kg/m2)	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, arterial blood pressure (BP) was recorded using a standard mercury column sphygmomanometer and stethoscope. The auscultatory method was employed. Clear sharp, tapping sound heard on lowering the mercury column was taken as SBP and disappearance of the Korotkoff sounds was taken as diastolic blood pressure (DBP).

Simultaneously ECG was recorded by a portable ECG machine, RMS VESTA 101 (RMS Recorders & Medicare Systems, Chandigarh). Heart rate (HR) was measured using an electrocardiograph (ECG) rhythm strip on limb lead II and calculated by dividing 1500 by the number of small squares between two R waves in the ECG tracing.

Pulse pressure (PP = SBP - DBP), mean pressure (MP = DBP + PP/3), rate pressure product [RPP = (HR × SBP)/100] and double product (Do P = HR × MP/100) were calculated for each recording. Three BP and HR recordings at 2-minute intervals were taken and the lowest of these values was included for the present study.

For breath holding time (BHT) subjects were asked to take a deep inspiration after normal respiration and then to hold the breath as long as he could do it. The time of breath holding was calculated by stopwatch.

40 mm Hg endurance test was conducted by asking the subject to take in a full breath and blow against the mercury column of sphygmomanometer to the pressure of 40 mm Hg, maximum time (in seconds) for which the subject could maintain the mercury level at 40 mm Hg was noted. The lips were secured tightly around the mouthpiece with the help of fingers to ensure that there was no leak. Care was taken to see that the subjects did not use oral muscles or tongue to develop pressure or to block tubing[4].

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

Data obtained for various parameters were subjected to statistical analysis using the Microsoft Excel and OpenEpi software (version 2.3.1). One-way ANOVA and appropriate post hoc test (Bonferroni multiple comparisons procedure) was used to study the changes within the group over the period of time and for inter group comparison. A p value of <0.05 was considered statistically significant.

OBSERVATION AND RESULT:

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

Table-3 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)	124.39±7.6	121.26±6.79 *	125.83±8.7	123.77±8.7
DBP (mmHg)	76.04±6.7	73.62±5.3	77.5±8.62	76.26±6.19
PP (mmHg)	48.35±9.4	47.64±8.17	48.33±11.26	47.51±9.95
MAP (mmHg)	92.16±5.48	89.5±4.46**	93.61±6.83	92.1±5.4
RPP (units)	96.69±12.65	89±8.54 **	96.74±11.01	93.32±9.28
Do P (units)	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.

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 Changes in BHT & Endurance test in Yoga and Physical exercise groups.

Parameter	Yoga Group		Physical Exercise Group	
	Pre	Post	Pre	Post
BHT (sec.)	51.66±12.62	60.41±9.78**	54.05±9.32	58.88±8.37ff
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.
ff P<.01 on comparing pre and post exercise group.

Yoga as well as physical exercise group showed statistically significant rise in BHT after training ($P<0.01$). Timing of respiratory Endurance test was also significantly ($p<0.01$) 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 resulted in appreciable and statistically significant improvement in most of the parameters measured in this study.

Our results are also consistent with the findings of other workers who have reported beneficial effects of Yoga training on cardiorespiratory functions.[5,6,7]

Yoga training showed significant reduction in heart rate and it is attributed to increased vagal tone and decreased sympathetic activity.[8,9] Decreased sympathetic activity in turn reduces catecholamine secretion and also leads to vasodilation leading to improvement in peripheral circulation. It is also observed that regular yogic practices reduce basal metabolic rate and resting oxygen consumption[10]. All these may be responsible for reduction in resting heart rate.

RPP and Do P 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 SBP, DBP, MAP, RPP and DoP but SBP, 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.

Breath holding test is used as a rough index of cardiopulmonary reserve. BHT of less than 20 seconds indicates diminished cardiac or pulmonary reserve.

Table 4 shows a significant increase in BHT in yoga group. Karmur KA et al[11], Ankad Roopa B et al[12] Lata M. Mullur et al[13] also found significant increase in BHT after short term Yoga practice. Improvement in BHT may be due to practice of Yoga which makes stretch receptors to withstand more stretching. Also the sensitivity of the respiratory center to carbon dioxide is reduced. Hence respiratory center can withstand higher carbon dioxide concentrations in the alveoli and the blood. With training subject can exercise voluntary control on the respiratory muscles overriding the excitatory stimuli to respiratory centres. In addition there is gradual acclimatization of receptors to the increased concentrations of carbon dioxide.[14]

In our study respiratory endurance test shows significant increase in timing after yoga training. It is due to increase in strength of respiratory muscles which delays the onset of their fatigue.

Present study showed prolongation of breath holding time after 3 month duration of physical training whereas respiratory Endurance test did not increase significantly after training period but a trend toward an increase in this test was observed. The result discussed above confirms that regular exercise increases the amount of oxygen delivered to the tissues and removal of carbon dioxide from the body. Physical training enhances the respiratory efficiency by increasing the

strength of diaphragm and intercostal muscles, and by increasing the number of alveoli. It increases the vital capacity and prolongs the breath holding time.15

CONCLUSION: The present study shows that 3 months yoga training produces a significant improvement in cardiorespiratory fitness, as compared to physical exercise group.

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