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*Original Article*

# A Comparison between Yoga and Aerobic Training Effects on Pulmonary Function Tests and Physical Fitness Parameters

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**ABSTRACT**

***Objective:*** We aimed to survey the effect of yoga and aerobic trainings on pulmonary and physical fitness factors of healthy female university students.

***Methodology:*** This quasi-experimental study included 60 healthy female students who were randomly assigned into two groups; exercising yoga and aerobics twice a week for three months. Respiratory rate (RR) along with Pulmonary Function Tests such as pulmonary capacities (PEF, PIF, FEV1, FVC), and physical fitness factors including flexibility, balance, and maximal aerobic capacity (vo2max), were measured at baseline and after applying trainings. We used spirometery, sit and Reach, one leg balance stance, and Bruce treadmill protocols for evaluating these variables. The data were analyzed using student (T – test) at P <0.05 significance level.

***Results***: Participants had a mean ±SD age of 19.02±2.19 years, height of 160.48±5.34 cm and weight of 56.7±10.7kg with no significant differences between the two groups. After training, in the yoga group; RR decreased, pulmonary and all physical fitness parameters except vo2max increased significantly (P < 0 .05). In the aerobic group; PEF and PIF increased significantly. There were no changes in RR, FEV1, FVC, however all physical fitness parameters improved significantly (P < 0.05).

***Conclusion:*** Our findings suggest that yoga training can lead to significant improvement in most variables except vo2max. Therefore regular practice of yoga seems to improve health related aspects of physical fitness and may enhance wellness.

**KEY WORDS:** Yoga, Aerobic exercise, Pulmonary function, Physical fitness factors.

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## INTRODUCTION

Yoga refers to a system of philosophy established in India thousands of years ago. It helps to develop spirit of harmony through coordinating mind and body. The practice of yoga uses eight methods, known as "limbs Yama (restraint), Niyama (observation), Asana (posture), Pranayama (breath control), Prathyaha (sensory deprivation), Phyana (fixing the attention), Dharana (contemplation) and Samadhi (absolute concentration). In yoga, the postural maneuvers are done without repetition and are called choreography. Evidence shows that regular practice of these choreographies provides more physical flexibility, muscle strength and decrease in physiological stress and cardiovascular diseases. Breath control (pranayama) is so important in yoga and is emphasized in all aforementioned eight methods.[1] It consists of conscious inhalation, retention and exhalation.[2]

Aerobic training is a non specific activity that improves physical and respiratory capacities. It is

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simple to carry out and includes jogging in place, knee ups, short kick, running, marching and so on.[1] The aim of this study was to compare the effect of yoga and aerobics on pulmonary function tests and physical fitness.

## METHODOLOGY

The present study was conducted at the Physical Education Department, University of Isfahan, Iran. It was a quasi-experimental supervised study. Sixty healthy female students who volunteered to engage in practice of yoga or aerobics were consecutively assigned in two groups. All individuals were physically healthy, and gave written informed consent.

***Data collection:*** Simple spirometery was performed using a portable spirometer (Jager, Masterscope Rotary, UK). Subjects were individually instructed on how to correctly breathe into the spirometer. The best two maneuvers with less than 10% variation between them were recorded and one with higher value was selected for analysis.[1] Selected spirometery factors were Peak expiratory flow(PEF), peak inspiratory flow (PIF), forced expiratory flow in first second (FEV1) and forced vital capacity(FVC). Physical fitness factors such as flexibility of hamstrings, balance and maximal aerobic capacity (vo2max) were also measured.

***Flexibility:*** Modified sit and reach box was applied to determine flexibility of hamstrings.[3]

***Balance:*** In order to measure the balance, we used one leg balance stand test.[4]

***Maximal aerobic capacity (vo2max):*** In order to measure the vo2max, we used Bruce treadmill test.[5] The treadmill used for this test was (h/p cosmos, mercury, Germany).

***Exercise protocol:*** Subjects exercised either yoga or aerobics one hour twice a week for three months. Yoga training consisted of warm up, breathing exercise (pranayama) including voluntary inhalation, retention, and then voluntary exhalation. Postural maneuvers (the choreography) generally consisted of 15 to 20 different positions, relaxation and meditation. Aerobic training included warm up and activities such as jogging, jumping, stationery aerobics, strength, flexibility, and cool down. All of exercises on training had specific principles such as intensity, frequency, time, specificity and overload.

***Statistical analysis:*** The collected data were analyzed via SPSS statistical analysis package version 19, using dependent T-student test to compare intergroup mean differences. Independent T- student test was also applied to compare mean differences between groups. The Significance level was set at $P < 0.05$.

## RESULTS

Yoga group started with 30 members but 3 of them failed to complete the course. Therefore yoga training course finished with 27 subjects. Aerobic group included 30 subjects. The mean age, height and weight of the subjects were 19.02±2.19 years, 160.48±5.34cm and 56.7±10.7kg respectively. The two groups were not statistically different in these regards. The subjects had no other physical activities three months prior to our study.

In yoga group statistical analysis revealed that there was a significant decrease in RR, and increase in pulmonary capacities (PEF, PIF, FEV1, FVC), flexibility of hamstrings and balance. However there was no significant difference in (vo2max) in the yoga group. Table-I shows pulmonary function and physical test results before and after completion of the training course in the yoga group. In aerobic group there were no significant differences in

Table-I: Comparison of pre and post training in yoga group.

| | *Pre training* | *Post training* | *P* |
|---|---|---|---|
| RR(frequency) | 11.3± 1.3 | 10.1 ± 2.0 | 0.02 |
| PEF (lit/s) | 5.8 ± 1.5 | 6.2 ± 1.3 | 0.00 |
| PIF (lit/s) | 4.05 ±1.1 | 4.7± 1.3 | 0.00 |
| FEV1 (lit) | 2.8 ± 0.4 | 2.8 ±0.4 | 0.01 |
| FVC (lit) | 2.8 ±0.4 | 2.9± 0.4 | 0.00 |
| Flexibility of hamstring (cm) | 35.5 ± 7.5 | 39.9 ±6.5 | 0.00 |
| Balance(s) | 3.4 ± 12.9 | 21.9 ±18.5 | 0.01 |
| Vo2max (ml/kg/min) | 30.9 ± 6.6 | 32.6± 4.1 | 0.15 |

RR: respiratory rate; PEF: peak expiratory flow; PIF: peak inspiratory flow; FEV1: forced inspiratory volume in first second; FVC: forced vital capacity.

Table-II: Comparison of pre and post training in aerobic group.

| | *Pre training* | *Post training* | *P* |
|---|---|---|---|
| RR (frequency) | 11.2± 1.7 | 10.5 ± 1.65 | 0.08 |
| PEF (lit/s) | 5.8 ± 1.3 | 6.2 ± 1.2 | 0.05 |
| PIF (lit/s) | 4.4 ±0.9 | 4.7± 0.8 | 0.03 |
| FEV1 (lit) | 2.9 ± 0.4 | 2.9 ±0.4 | 0.08 |
| FVC (lit) | 3.1 ±0.5 | 3.5± 0.4 | 0.68 |
| Flexibility of hamstring (cm) | 35.9 ± 8.2 | 39.2 ±7.04 | 0.00 |
| Balance(s) | 10.5 ± 12.1 | 23 ±17.4 | 0.00 |
| Vo2max (ml/kg/min) | 33.4 ± 6.9 | 39.9± 6.7 | 0.00 |

RR: respiratory rate; PEF: peak expiratory flow; PIF: peak inspiratory flow; FEV1: forced inspiratory volume in first second; FVC: forced vital capacity.

RR, FEV1, FVC, however PEF, PIF, flexibility of hamstrings, balance and (vo2max) improved significantly.

Table-II shows pulmonary function and physical test results pre and post training in aerobic group. Table-III shows present mean differences of the two groups. Such results show that yoga and aerobic groups had the same results in most variables except RR and vo2max.

Table-III: Comparison of mean differences of yoga and aerobic group.

| | *Mean differences pre & post yoga* | *Mean differences pre & post yoga* | *P* |
|---|---|---|---|
| RR (frequency) | 0.63 ±1.9 | 1.1± 2.3 | 0.03 |
| PEF (lit/s) | -0.4± 1.1 | -0.4± 1.1 | 0.98 |
| PIF (lit/s) | -0.4± 1.1 | -0.4± 0.6 | 0.98 |
| FEV1 (lit) | 1.06± 0.2 | -0.07± 0.1 | 0.72 |
| FVC (lit) | 0.03± 0.5 | -4.4± 3.9 | 0.09 |
| Flexibility of hamstring (cm) | 3.2± 3.0 | 8.5± 1.58 | 0.21 |
| Balance(s) | 12.9± 12.6 | 6.5 ±8.3 | 0.25 |
| vo2max (ml/kg/min) | 1.7 ±6.0 | -6.5 ± 8.3 | 0.01 |

RR: respiratory rate; PEF: peak expiratory flow; PIF: peak inspiratory flow; FEV1: forced inspiratory volume in first second; FVC: forced vital capacity.

## DISCUSSION

The present study demonstrated that practicing yoga and aerobics one hour twice a week for three months had similar effects on most pulmonary and physical fitness variables except for RR and vo2max. RR had a significant decrease after yoga. Telles et al reported changes in autonomic and respiratory variables by 2 meditative states described in texts of yoga. There were significant decreases in breath rate and heart rate and a significant increase in skin resistance level.[6] Harinate et al reported the same changes for respiratory rate.[7] Joshi showed that practicing pranayama for 8 weeks improved pulmonary function tests such as FEV1, FVC, PE, MVV(maximum voluntary ventilation) and decreased RR.[8] QR Ahmed et al reported the same findings in the elderly.[9] Similar beneficial effects were reported by Macwana et al .[10] Wisniewski et al reported that pranayama improved the airway reactivity in asthmatic patients.[11]

Mandamahan et al reported that training of yoga for 6 weeks increased respiratory pressure significantly.[12] In another study they had reported that 12 weeks of yoga training put a significant increasing effect on breath holding time, maximum inspiratory pressure, breath holding time after inspiration and expiration and strengthening of hand grip.[13] Telles et al mentioned that slow breathing in pranayama exercises improved the autonomic nervous system and increased the activation of parasympathetic system.[14] Mandanmuhan showed that yoga training could improve FEV1 and PEF in students significantly.[15] All the above mentioned studies confirm our findings. On the other hand Dagoberto et al compared yoga and aerobics and their effects on spirometery and maximal inspiratory pressure (MIP). They measured MIP, FEV1, and FVC. These variables had no significant improvement in both groups.[1] Their findings did not support those of the present study.

It seems that increase in expiratory and inspiratory pressures were because of respiratory muscles strengthening. Respiratory muscles and skeletal muscles are just alike. Yoga training involves isometric contraction, which is known to improve muscular strength.[16]

In this study we also found that both yoga and aerobic training significantly improved flexibility and balance, but vo2max improved significantly only after aerobic training. Vishav G. investigated the effects of yoga on physical fitness including agility, strength, power, cardiovascular endurance and speed. Results indicated that these variables improved significantly except for cardiovascular endurance.[17] Tracy et al reported about Bikram yoga training and its effects on isometric dead lift, hand grip strength, lower back-hamstring and shoulder flexibility, blood pressure, resting heart rate, maximal o2 consumption, lean and body fat mass. After training, all these variables improved significantly except hand grip strength and maximal o2 consumption.[18] In another study by Bal et al it was reported that selected assanas in Hatha yoga had a significantly increasing effect on agility and flexibility.[19] Galantino et al demonstrated that 6 weeks of selected Hatha yoga training increased flexibility and balance significantly.[20]

Clay CC et al reported that 30 minutes of Hatha yoga made an average heart rate of 105 beats per minute in middle-aged women. The energy cost of such an activity was only 10% greater than sitting on a chair and approximately half of what is required for walking on treadmill with 3.5 mph. They concluded that practicing of Hatha yoga had a little cardiovascular benefit.[21]

About beneficial aspects of flexibility Tsolakis mentioned that stretching enhanced performance and reduced risk of injures by improving Joints

mobility.[22] About beneficial aspects of balance, McKeon reported that balance training was recommended prophylactically to preve nt first-time sprains and after injury to prevent secondary ankle sprains.[23]

Our findings suggest that yoga like other physical activities, could be used to enhance some health aspects especially in people for whom ordinary physical activities seem hard to do. We thought that practice of pranayama, with respect to its effect on pulmonary capacities, may be useful in patients with chronic obstructive lung diseases; typically asthma. Yoga also put a significant improvement on flexibility and balance. Therefore yoga could be recommended to reduce sport injuries like sprains and falling.

## CONCLUSION

This study findings show that eight weeks of yoga training can significantly improve some physical fitness parameters in young healthy female individuals. More specifically, yoga training seems to decrease RR, and increase PEF, PIF, FEV1, FVC, balance and flexibility. This study proposes that regular practice of yoga can improve health related aspects of physical fitness and general wellbeing.

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