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Original Research

Evaluation of impact of moderate and high intensity exercise on lung volumes, lung capacities, and Breath holding time

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ABSTRACT:
Background: Physical exercise is an integral part of pulmonary rehabilitation programs. The present study was conducted to evaluate the impact of moderate and high intensity exercise on lung volumes, lung capacities, and breath holding time. **Materials & Methods:** 80 healthy subjects of both genders were divided into 2 groups of 40 each. Group I subjects performed moderate-intensity continuous exercise and group II subjects performed high-intensity exercise. Pulmonary functions were recorded using a computerized spirometer. The values of VC, TV, IRV, and ERV were noted. **Results:** The mean age in group I was 34.6 years and in group II was 35.2 years, weight was 60.2 Kgs and 58.8 Kgs, height was 172 cm in group I and 170.4 in group II and waist- hip ratio was 0.97 in group I and 0.86 in group II. The mean change in TV (litres) was 0.02 and 0.03, IRV (litres) was 0.26 and 0.37, IC (litres) was 0.70 and 0.42, VC (litres) was 0.36 and 0.58, ER (litres) was 0.08 and 0.21, EC (litres) was 0.12 and 0.20 and BHT (Seconds) was 1.42 and 4.38 in group I and II respectively. There was a positive correlation of all three parameters with BHT but it was not significant. The correlation of BHT with IC was strongest, whereas that with VC was weakest. **Conclusion:** There was improvement in VC, IC, EC, and BHT after exercise training sessions in both the moderate intensity and high-intensity exercise groups.
Key words: Exercise, Lung volumes, intensity activity

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INTRODUCTION

Activity is defined as engaging in either 75 minutes of vigorous intensity activity per week or around 150 minutes of moderate-intensity activity per week. Lack of physical activity and occurrence of obesity caused by sedentary life style are the causes for concern globally.[1] A large percentage of India's population is physically inactive, with less than 10% of Indians engaging in physical activity. Most countries in Asia are developing countries, and fewer are underdeveloped. Although the percentage of people below the poverty line varies across developing and underdeveloped countries, the addiction to television and cell phones in general in the population is leading to lack of physical activity and to a sedentary life style.[2] Physical exercise is an integral part of pulmonary rehabilitation programs. The principles of training are exercise duration, frequency, progression, modality, individualization, and, especially, intensity, which is considered as the key determinant of the physiological benefits gained from rehabilitation.[3] According to the American College of Sports Medicine, moderate-intensity continuous aerobic exercise for 20 to 60 minutes per session brings

physiological benefits, whether on a treadmill or a cycle ergometer, the latter resulting in lower exercise induced oxygen desaturation in the training of patients with COPD.[4] Studies have explored the benefits of moderate intensity and high-intensity exercises on pulmonary functions, and most of them evaluated the parameters forced vital capacity (FVC) and forced expiratory volume (FEV1) in 1 second. But there is a paucity of studies evaluating vital capacity (VC), inspiratory capacity (IC), expiratory capacity (EC), and breath holding time (BHT) for lung endurance and lung dynamics after moderate- and high-intensity exercise training.[5] The present study was conducted to evaluate the impact of moderate and high intensity exercise on lung volumes, lung capacities, and breath holding time.

MATERIALS & METHODS

The present study comprised of 80 healthy subjects of both genders. All were taken into the study after they agreed to participate. Data such as name, age, gender etc. was recorded. Subjects were divided into 2 groups of 40 each. Group I subjects performed moderate-intensity continuous exercise at a heart rate of 50-74% of their maximum heart rate for a duration of 40 minutes, 5 days a week. Group II subjects performed high-intensity exercise for 8 seconds by sprint cycling at 75- 84% of their maximum heart rate followed by 12 seconds of low-intensity cycling for a duration of 20 minutes, three times per week, on a bicycle ergometer. These exercise training sessions were conducted for 12 weeks. Pulmonary functions were recorded using a computerized spirometer. The values of VC, TV, IRV, and ERV were noted. The IC was calculated by adding values of TV and IRV, while EC was estimated by adding TV and ERV. For BHT, the participants were instructed to take a deep breath and then blow through the mouthpiece of a mercury manometer until pressure was elevated to 40 mm Hg. Results were studied and determined statistically. P value less than 0.05 was considered significant.

RESULTS

Table I Baseline characteristics

Parameters	Group I	Group II	P value
Age (years)	34.6	35.2	0.91
Weight (Kgs)	60.2	58.8	0.82
Height (cm)	172.0	170.4	0.74
Waist- hip ratio	0.97	0.86	0.12

Table I shows that mean age in group I was 34.6 years and in group II was 35.2 years, weight was 60.2 Kgs and 58.8 Kgs, height was 172 cm in group I and 170.4 in group II and waist- hip ratio was 0.97 in group I and 0.86 in group II. The difference was significant (P< 0.05).

Table II Change in pulmonary function between group I and group II post completion of 12 weeks exercise training

Parameters	Group I	Group II	P value
TV (litres)	0.02	0.03	0.05
IRV (litres)	0.26	0.37	0.17
IC (litres)	0.70	0.42	0.02
VC (litres)	0.36	0.58	0.03
ER (litres)	0.08	0.21	0.05
EC (litres)	0.12	0.20	0.15
BHT (Seconds)	1.42	4.38	0.01

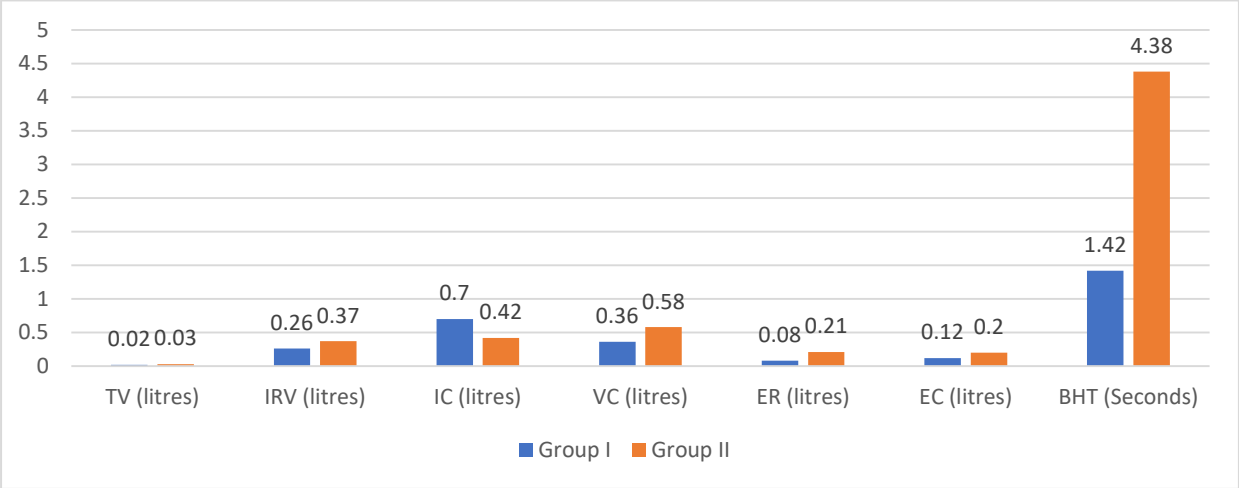
Table II, graph I shows that mean change in TV (litres) was 0.02 and 0.03, IRV (litres) was 0.26 and 0.37, IC (litres) was 0.70 and 0.42, VC (litres) was 0.36 and 0.58, ER (litres) was 0.08 and 0.21, EC (litres) was 0.12 and 0.20 and BHT (Seconds) was 1.42 and 4.38 in group I and II respectively. The difference was significant (P< 0.05).

Table III Correlation between pulmonary functions and breath holding time (BHT) in moderate-intensity exercisers post-12 weeks training

Parameters	R value	P value
IC and VHT	0.42	0.12
VC and BHT	0.28	0.27
EC and BHT	0.32	0.19

Table III shows that there was a positive correlation of all three parameters with BHT but it was not significant. The correlation of BHT with IC was strongest, whereas that with VC was weakest.

Graph I Change in pulmonary function between group I and group II post completion of 12 weeks exercise training



DISCUSSION

The impact of a sedentary lifestyle on the occurrence of non-communicable diseases is similar in countries around the world.[6] Exercise enhances cardiovascular health and also influences muscular bulk and neuromuscular stability.[7] On the other hand, sedentary lifestyle, obesity, frequent eating habits, and environmental pollution are all factors that contribute to compromised lung functions, may lead to cardiorespiratory disorders, and can increase morbidity and mortality rates. Because of people's stressful lifestyles, exercise and fitness have received greater awareness in today's world.[8] Taking time out of a busy schedule is a practical problem, and maintaining exercise practices consistently becomes difficult. Moreover, much research is being conducted to assess the beneficial effects of moderate-intensity/long duration and high-intensity/short-duration exercises on cardiorespiratory health.[9] The present study was conducted to evaluate the impact of moderate and high intensity exercise on lung volumes, lung capacities, and breath holding time. In present study, mean age in group I was 34.6 years and in group II was 35.2 years, weight was 60.2 Kgs and 58.8 Kgs, height was 172 cm in group I and 170.4 in group II and waist- hip ratio was 0.97 in group I and 0.86 in group II. Gangwar et al[10] evaluated the benefits of moderate- and high- intensity exercise training on pulmonary health and analyzed the correlation between lung volumes, capacities and respiratory muscular strength. The participants were randomly divided into two groups of 15 each and performed moderate-intensity and high- intensity exercise respectively. Their pulmonary functions were analyzed using a spirometer. The Breath holding time was recorded with a 40 mmHg test. High-intensity exercise training was found to enhance the breath holding time, vital capacity, inspiratory capacity and expiratory capacity more than moderate-intensity exercise. There was a weaker linear positive correlation between breath holding time and lung capacities. We observed that mean change in TV (litres) was 0.02 and 0.03, IRV (litres) was 0.26 and 0.37, IC (litres) was 0.70 and 0.42, VC (litres) was 0.36 and 0.58, ER (litres) was 0.08 and 0.21, EC (litres) was 0.12 and 0.20 and BHT (Seconds) was 1.42 and 4.38 in group I and II respectively. Whitelaw et al[11] studied the mechanism by which a larger lung volume decreases the discomfort of breath holding and increases BHT. They analyzed the pressure waves of diaphragm contractions after breaths were held at various lung volumes. They found that expiratory muscle activity was more prominent in fewer individuals and the activity increased through each breath hold. Thus, as observed in our study, the principle of force-length and geometric properties might be the reason for the increased EC with cardiorespiratory exercise training. We observed that there was a positive correlation of all three parameters with BHT but it was not significant. The correlation of BHT with IC was strongest, whereas that with VC was weakest. Nourry et al[12] investigated the effects of short duration running training on resting and exercise lung function in healthy prepubescent children. One trained group (TrG) (n = 9; three girls and six boys; age = 9.7 +/- 0.9 year) participated in 8 weeks of high-intensity intermittent running training and was compared to a control group (ContG) (n = 9; four girls and five boys; age = 10.3 +/- 0.7 year). At peak exercise, TrG displayed higher values of peak oxygen consumption (+15 +/- 4% ; P < 0.001), minute ventilation (+16 +/- 5% ; P = 0.033) and tidal volume (+15 +/- 5% ; P = 0.019) after training. At sub-maximal exercise, ventilatory response to exercise DeltaV(E)/DeltaV(CO(2)) was lower (P = 0.017) in TrG after training, associated with reduced end-tidal partial oxygen pressure (P < 0.05) and higher end-tidal partial carbon dioxide pressure (P = 0.026). Lower dead space volume relative to tidal volume was found at each stage of exercise in TrG after training (P

< 0.05). Eight weeks of high-intensity intermittent running training enhanced resting pulmonary function and led to deeper exercise ventilation reflecting a better effectiveness in prepubescent children.

CONCLUSION

Authors found that there was improvement in VC, IC, EC, and BHT after exercise training sessions in both the moderate intensity and high-intensity exercise groups.

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