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Original Research Article

Does regular physical exercise enhance pulmonary function in athelets? : A cross-sectional study

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Abstract

Introduction -Lung function parameters tend to have a direct relationship with regular exercise. Due to regular exercise, sportsmen tend to have increased pulmonary capacity when compared to non-exercising individuals. Objective of the study was to compare the difference in pulmonary function tests [Vital Capacity (VC), Forced Expiratory Volume in 1 second (FEV1), Maximum Voluntary Ventilation (MVV)] among sportsmen and sedentary control group.

Material and Methods - Study population consist of 100 subjects in age group of 18 to 25 years, out of which 50 subjects were sportsmen engaged in sports for at least 3-5 years and 50 subjects comprised the sedentary control group. Both groups were examined for pulmonary function tests (VC, FEV1, and MVV).

Results - Sportsmen and control group comparison was analyzed by applying unpaired "t" test. Significant P-value was set at less than 0.05 ($P < 0.05$). In our study it was observed that pulmonary function tests (VC, FEV_1, and MVV), were significantly higher in sportsmen as compared to control group.

Conclusion - Training and the physical activity has a definite beneficial effect as far as the respiratory functions are concerned. The result of this study strongly recommends regular physical exercise for the sedentary medical students.

Keywords - Sportsmen, Vital capacity (VC), Forced expiratory volume in 1 second (FEV1), Maximum Voluntary Ventilation (MVV), Pulmonary function tests.

Introduction:

The pulmonary functions, like other physiological tests, are of immense importance for measuring the fitness of the individual from a physiological point of view.

Pulmonary function and its relation to athletic performance, has been a controversial topic among exercise researchers. Many researchers stated that the respiratory system can impact the strength and exercise performance in trained athletes. [1,2] Lung function parameters tend to have a direct relationship with regular exercise.[3,4] Due to regular exercise, sportsmen tend to have increased pulmonary capacity when compared to non-exercising individuals. Sedentary life styles could be associated with less efficient pulmonary function.

Intensity and severity of sports engaged in by the sportsmen probably determines the extent of strengthening of the inspiratory muscles with a resultant increase in the pulmonary functions [5]. Hence pulmonary functions are generally

determined by the strength of respiratory muscles, compliance of the thoracic cavity, airway resistance and elastic recoil of the lungs.[6]The Pulmonary Function Capacities of normal sedentary persons have been studied more commonly in India[7-10] but less than in sport population.

Pulmonary function tests (PFT) serve as a tool of health assessment and also to some extent as a predictor of survival rate. Regular exercise as in athletes produces a positive effect on the lung by increasing pulmonary capacity and thereby improving the lung functioning.

Hence, the present study was undertaken with a view to determine the pulmonary functional capacities of the different groups of sportsmen and to compare them with those of sedentary persons.

Material and methods:

The study population comprised of sportsmen and sedentary group selected from medical college. Sportsmen group consisted of players involve in various sports like football, hockey, sprinters, swimmers, athletes. Sedentary group comprised subjects with less physical activity. The subjects were carefully selected at random from medical college aged between 18-25 years, non-obese and willing to participate in the study. All of them were nonsmokers and free from active respiratory diseases. Sportsmen were selected randomly from local sport institute, playing sport since 3-5 years.

The informed consent was obtained and procedure was explained to each subject during test. The pulmonary function tests were carried using RMS Helios spirometer.

Anthropometric measurements like height and weight of each subject was measured before the test procedure. Information was gathered regarding the personal history, about smoking, recent respiratory illness, medications used etc. and also elicited about the family history of any respiratory disease.

Evaluation of Vital capacity (VC), Forced Expiratory Volume in 1 second (FEV1) and Maximum voluntary ventilation (MVV) was done.

Statistical analysis:

The detailed data was entered into the Microsoft excel sheet and subsequently analyzed by using SPSS (Statistical package for social science) 11.5 software. Values were reported as Mean ± SD. Sportsmen and control group comparison was analyzed by applying unpaired “t” test. Significant P-value was set at less than 0.05 ($P < 0.05$).

Results:

Table I: Mean values of physical characteristics in sportsmen and control Group

Sr. No.	Parameters	Sportsmen (Mean ±SD)	Control group (Mean ±SD)	P value
1	Age (years)	20.18± 2.19	20.12±2.22	>0.05
2	Height (cm)	170.3±6.39	179.7±6.08	>0.05
3	Weight (kg)	64.96±8.55	63.82±8.72	>0.05

Table II - Comparison of Vital capacity between Control & Sportsmen

	Vital capacity (Liters)	
	Control	Sportsmen
Mean	3.495	3.880
SD	±0.41	± 0.43
SEM	0.058	0.061
P	P<0.001 (Significant)	

Table III - Comparison of FEV1 between Control & Sportsmen

	FEV1 (liters)	
	Control	Sportsman
Mean	3.294	3.574
SD	± 0.41	± 0.36
SEM	0.057	0.051
P	P<0.001 (Significant)	

Table IV - Comparison of MVV between Control & Sportsmen.

	Maximum Voluntary Ventilation (MVV) (Lit/min)	
	Control	Sportsmen
Mean	113.3	139.9
SD	±17.95	±13.68
SEM	2.53	3.19
P	P<0.001 (Significant)	

Discussion:

There was no significant difference in age, height and weight (p>0.05) between Control and sportsmen group. That means the two groups were comparable with respect to these parameters. (Table no. I)

Vital capacity in sportsmen (3.880±0.43) liters was higher than in control group (3.495±0.41) liters. The difference between vital capacity of sportsmen and control group was statistically significant (p<0.001). (Table no. II)

De AK observed high values of VC in Bengalese football goalkeepers.[11]

Olufeyi Adegoke found increased value of vital capacity in Nigerian athletes as compared to non athletes. [12] Doherty M. and Dimitrioul L found more vital capacity in Greek swimmers as compared to land based athletes and sedentary *controls*.[13] Cordain et al found higher values of VC in sportsmen [14] Barlett HL and Mance MJ found less value of vital capacity in gymnasts as compared to runners.[15]

Vital capacity is determined by the lung dimensions, compliance and respiratory muscle power. Regular exercise has proven to be beneficial for human body especially for the heart and lungs. Cardiovascular system and respiratory system are benefited due to improved vascularity and more efficient circulation to them. The present study was attempted to study the effects of physical training on lungs function.

Results from the present study strongly suggest that the intensity or severity of the sports engaged by the sportsmen probably determines the extent of strengthening of the respiratory muscles with resultant increase in the lung volumes. Regular physical training not only improves the strength of skeletal and cardiac muscle, but also improves the accessory muscles of inspiration and expiration. This finding can be explained on the basis of better endurance of respiratory muscles in sportsmen. Training of the muscles of the shoulder girdle leads to an increase in vital capacity due to increased strength of accessory muscles of respiration.[6]

FEV1 in sportsmen (3.574±0 .36 liters) was significantly higher than in control group (3.294±0.41 liters). (Table no III)

Onadekob found high values of FEV1 in Nigerian athletes as compared to nonathletic [15] Recently Shobhadevi et al and Shashikala L found higher FEV1 in athletes.[16,17] P.K.Mehrotra et al also found increased values of FEV1 in sportsmen playing football, volleyball, basketball and swimmers as compared to the control group [18] Doherty M.

and Dimitrioul L found less values of FEV1 in land based athletes as compared to swimmers[13]. Ayesha AK and et al. did not observe any significant change in FEV1.[19]

The present study shows higher values of FEV1, this might be due to strengthening of respiratory muscles as a result of physical training. There might be an increase in the maximal shortening of the inspiratory muscles due to effect of training. Exercise has a facilitating effect on lung function. One of the factors affecting the forced expiratory volume is airway resistance. The airway resistance may be doubled by bronchial smooth muscle contraction or reduced to half the normal by bronchodilation. The effect of sympathetic system and epinephrine on bronchial tone is to dilate the airway. The increased sympathetic tone during muscular effort tends to lower the airway resistance.[6] Thus increased respiratory muscle endurance rather than decreased airway resistance appears to be the probable explanation for increased FEV1 in sportsmen. Possible explanation for this could be regular forceful inspiration and expiration for prolonged period during training leads to strengthening of the respiratory muscles. This helps the lungs to inflate and deflate maximally.

Maximum voluntary ventilation (MVV) in sportsmen (139.9±13.6)Lit/min was significantly higher than in control group (113.3±17.95) Lit/min. (Table IV)

Ghosh AK et al[20] found higher mean values of MVV in sportsmen as compared to sedentary control group. Pringle EM et al found more values of MVV in 10 km runners. It was observed that running improved strength of respiratory muscles in runners. [21] De AK found more values of MVV in Kabbadi players as compared to physical education students. [11].

MVV has been used to assess endurance performance of respiratory muscles. Values of MVV depend on factors like maximum achievable respiratory rate during voluntary hyperventilation, patency of airways and tone of the respiratory musculature.

Thus finding of the present study can be attributed to better achievable respiratory rate and depth which may be due to better respiratory muscle endurance and increased tone and strength of respiratory muscles in sportsmen. It was observed that intense inspiratory muscle training results in increased lung volume.

Physical training has a facilitative effect on ventillatory function and athletes have higher lung function values as compared to non athletes.[22]

It has been shown that there is an improvement in lung volumes after prolonged training due to the strengthening of respiratory muscles, both voluntary and involuntary. In prolonged training, due to the maximum inflation and deflation of lungs, there is stimulation of release of surfactant and prostaglandins in alveolar spaces, thereby increasing lung compliance and decreasing the bronchial smooth muscle tone.[24] Some researchers found increased values of VC, MVV, and FEV1. Ghosh AK et al found increased value of (VC), (MVV), and FEV1 in sportsmen belonging to different sports activities.[20] De AK et al found high values of VC, MVV, and FEV1 in inter-university kabbadi players. This might be due to breathing exercises done by the participants, who were accustomed to take maximum inspiration followed by slow expiration along with chanting during the course of the game.[25] Hagberg JM and Yerg JE found that there was a significant increase in vital capacity, maximum voluntary ventilation, and FEV1 in comparison with older sedentary group when normalized for age and height.[26] *Shashikala et all*.[27] shows that the Pulmonary Function Tests values are higher after exercise training. The cause for this could be regular

forceful inspiration and expiration for prolonged period during training leading to the strengthening of respiratory muscle. *Narayan Bahadur Mahotra et al*[28]shown that athletes have increased pulmonary function test as compared to sprinters.

Varsha Akhade, et al [29] studied that there is significant positive relationship between running training and pulmonary function in healthy young men. Lazovic-Popovic B et al [30] found that Swimmers had statistically higher values of VC, FVC, FEV1 when compared to both the football players and the controls. Mazic S et al [31] shown that basketball, water polo players and rowers had statistically higher vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in one second (FEV1) than the healthy sedentary control individuals. Sridip Chatterjee et al [32] studied that regular physical activity may be a strategy to delay the age related decline of respiratory physiological function for all the age groups and thus promote healthy aging. Therefore, exercises a nonpharmacological complementary alternative method recommended for efficient functioning of the lung trough out life.

Summary and conclusion:

The present study was mainly aimed to show the effect of training on pulmonary functions and. It revealed that the physical activity has a definite effect as far as the respiratory functions are concerned. The result of this study strongly recommends regular physical exercise for the sedentary medical students. Medical students are always under tremendous stress which affects their work output and this is precipitated by sedentary life style. Regular physical exercise will definitely improve their cardio-respiratory fitness and will help them to lead a better quality of life.Secondly, evaluation of these results will also help sportsmen to decide the type of sport for which they are best suited.

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