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RESEARCH ARTICLE

Evaluation of pulmonary function in sportsmen playing different games

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ABSTRACT

Background: The type of sports and the training and regular exercises make athletes to have an increase in pulmonary function test (PFT) parameters. Intensity and severity of sports performed by the athletes usually determine the extent of strengthening of the inspiratory muscles and the alveolar size with a resultant increase in the lung functions. **Aims and Objectives:** The aim of this study is to study the PFTs in male swimmers, marathoners, cricket players, and kabaddi players and to compare the same with matched sedentary control group. **Materials and Methods:** In this study, PFTs such as forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), maximum voluntary ventilation (MVV), and peak expiratory flow rate (PEFR) parameters were studied in 46 swimmers, marathoners, cricket players, and kabaddi players in the age group of 18-25 years. These parameters were compared with matched apparently normal healthy sedentary medical students using unpaired *t*-test. **Results:** In this study, a significant increase was observed in PFT parameters of swimmers, marathoners, cricket players, and kabaddi players than sedentary controls. The study group had a higher mean of percentage value of FVC, FEV1, MVV, and PEFR than controls. However, swimmers ($P < 0.0001$) had highest pulmonary parameters than marathoners, cricket players, and kabaddi players (<0.05). **Conclusion:** This study shows that PFTs were higher among sportsmen compared to sedentary controls. This shows the positive effect of training on respiratory system. In addition to this, the difference of PFTs between different sports types shows that the sports branch influences the pulmonary capacity.

KEY WORDS: Games; Forced Expiratory Volume in First Second; Forced Vital Capacity; Peak Expiratory Flow Rate; Pulmonary Function Test

INTRODUCTION

Pulmonary function test (PFT) parameters are influenced by genetic factors, ethnic characteristics, environmental pollution, physical activity, altitude, and to a minor extent by nutritional and socioeconomical factors.[1] Impaired PFTs are associated with increased mortality and morbidity.[2-4] Physical activity is known to improve physical fitness and to reduce morbidity and mortality from numerous chronic ailments.[5-7]

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Although PFT is genetically regulated and its function is among others influenced by the environmental and alimentary factors, the previous studies have shown that it can be improved by bodily exercise.[8,9] PFT is also influenced by the type of the sports played.[10] PFT tests provide a qualitative and quantitative evaluation of PFT and are of the highest importance in estimating the fitness of an individual from a physiological point of view.[11] Spirometry is the most commonly used lung function test in the objective assessment of respiratory system function.[12]

There are several studies that have shown significant improvement in PFTs as a result of the effect of exercise.[13-16] However, there are studies which show a non-significant change in PFTs in athletes.[10,17,18] Sedentary lifestyles could be associated with less efficient PFTs and playing different games regularly could produce a positive effect on the lungs by increasing pulmonary capacity, and thereby improving the pulmonary functioning.

The purpose of this study was to investigate whether there are differences in PFTs of the sportsmen playing different games and the sedentary males who are in the same age group with the sportsmen and to establish a relationship between the quality of exercise performed and the quantitative effect of these exercises on the respiratory system.

MATERIALS AND METHODS

This study was conducted in the Department of Physiology, Dr. V M Medical College, Solapur, after obtaining the institutional ethical clearance. The present study included 46 male swimmers, 46 marathoners, 46 cricket players, and 46 kabaddi players aged between 18 and 25 years, who were residents of Solapur district and were practicing at Park Stadium at Solapur, for about 2-4 h per day for at least 5 days in a week regularly for 3-6 years. A similar number of age, sex, height, and weight-matched medical students not directly involved in any kind of sports activity selected as controls. The informed consent was obtained after the detailed procedure and purpose of the study were explained.

Those with a history of chronic respiratory disorders, cardiovascular disorders, systemic diseases affecting respiratory system, alcoholics, and smokers were excluded from the study. A thorough history taking and clinical examination were carried out to rule out the exclusion criteria, and the vital data were recorded. Standing height was measured without footwear with subjects back in contact with the wall and with both heels together and touching the base of the wall. Weight was recorded with light clothing using a digital weighing machine. Both the height and weight were measured to the nearest 0.1 cm and 0.5 kg, respectively.

Spirometry was done on both sportsmen players and control groups with Medspiror a portable, computerized pneumotachometer (manufactured by Medsystems Pvt., Ltd., Chandigarh). The recordings were carried out at an average temperature of 28°C between 9 am and 11 am. All the maneuvers were performed with the subjects in sitting position. Thorough instructions were given to each sportsmen regarding the test, and sufficient time was provided for them to practice the maneuvers. A soft nose clip was put over the nose to occlude the nostrils, and disposable mouthpieces were used to minimize cross infection. Three readings were taken, and maximum reading was selected to print.

Statistical Analysis

The data obtained were expressed as mean and standard deviation, and Student's unpaired *t*-test was applied for comparison between two groups. A $P < 0.05$ was considered to be statistically significant.

RESULTS

The recorded anthropometric data in sportsmen and control groups did not show any statistical significance as shown in Table 1. The present study shows significant increase in PFT parameters of swimmers, marathoners, cricket players, and kabaddi players than sedentary controls. The study group had higher mean of percentage value of forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), maximum voluntary ventilation (MVV), and peak expiratory flow rate (PEFR) than controls. However, swimmers ($P < 0.0001$) had highest pulmonary parameters than marathoners, cricket players, and kabaddi players (<0.05) as shown in Table 2.

DISCUSSION

Exercise is a stressful condition which produces a marked change in body functions and lungs are no exception. Exercises in the form of sports, aerobics, or workouts if performed regularly have a beneficial effect on the various systems of the body. PFT is governed by genetic, environmental, and nutritional factors and confirms that physical training during growth helps in developing a greater endurance in respiratory muscles. Lung size may increase by a strenuous and prolonged strength training regimen during adolescence.[10]

This study has examined whether playing sports and the type of sports had an impact on PFTs in both sportsmen and sedentary-matched controls.

This study clearly shows that among sportsmen and sedentary controls, swimmers, marathoners, cricket players, and kabaddi players have statistically significant values

Table 1: Anthropometric data of sportsmen and controls

Sportsmen	Mean±SD			
	Age (year)	Height (cm)	Weight (kg)	BMI (kg/m^2)
Swimmers	22.62±2.46	165.14±6.35	60.42±6.54	22.03±12.23
Marathoners	22.52±3.40	167.33±9.58	63.35±9.49	22.58±21.56
Cricket players	23.32±4.32	168.23±8.49	64.35±9.36	22.94±14.54
Kabaddi players	21.30±2.40	165.32±6.54	64.32±9.48	23.50±16.34
Controls	22.16±2.25	166.24±2.31	61.32±4.51	22.13±10.32

P>0.05 (Not significant), SD: Standard deviation, BMI: Body mass index

Table 2: PFT parameters of sportsmen and controls

Sportsmen	FVC (L)	FEV1 (L/s)	PEFR (L/s)	MVV (L)
Swimmers	3.43±0.64***	2.81±0.56***	10.59±0.84***	156.28±13.21***
Marathoners	3.10±1.34*	2.71±0.82*	9.35±4.89*	144.24±10.63*
Cricket players	2.96±1.10*	2.68±0.64*	8.35±1.36*	142.44±01.06*
Kabaddi players	2.88±0.82*	2.66±0.63*	8.15±0.46*	143.96±11.24*
Controls	2.62±0.24	2.43±0.24	7.32±2.31	132.61±32.63

*$P<0.05$, ***$P<0.0001$, FVC: Forced vital capacity, FEV1: Forced expiratory volume in first second, PEFR: Peak expiratory flow rate, MVV: Maximum voluntary ventilation, PFT: Pulmonary function test

($P < 0.001$) of FVC, FEV1, MVV, and PEFR. There was no significant difference ($P < 0.001$) in FEV1/FVC between sportsmen and sedentary controls.

Muscular exercise increases the rate and depth of respiration and so improves FVC, the consumption of O_2, and the rate of diffusion.[18] In the Amsterdam Growth and Heart study, physical activity was observed to be positively correlated to changes in FVC between ages of 13 and 27 years over 15 years.[19]

FEV1 was significantly high in swimmers, runners, and cricket players than controls. Hence, it can be stated here that the physically trained individuals may have higher ventilatory capacity as well as FEV1. This might have been brought about by the fact that physical training not only improves the strength of skeletal limb and cardiac muscle but also improves the accessory muscles for inspiration and expiration.[13]

MVV which depends both on the patency of airways and strength of respiratory musculature was significantly high in swimmers, runners, and cricket players than controls. MVV improvement might be due to superior expiratory power and overall low resistance to air movement in the lungs. The higher MVV value is advantageous for physical work capacity.[20,21]

The mean expiratory flow rate (PEFR) of swimmers, runners, and cricket players was significantly higher than matched control group. The PEFR is an effort-dependent parameter emerging from the large airways within about 100-120 m of the start of the forced expiration.[22,23] PEFR can be, therefore, an easy test for quick assessment of improvement of an overall PFT of the sportsmen.

Among all the sportsmen chosen for this study, the swimmers showed the highest value of pulmonary parameters. This could be due to better PFTs. Regular swimming practice may tend to alter the elasticity of the lungs and the chest wall which leads to improvement in the PFT of swimmers.[24,25] In swimming, there is strenuous exercise of the respiratory muscles because the load of the water pressure against the chest wall and elevated airway resistance as the result of immersion could comprise a conditioning stimulus as well as the requirement that inspirations must occur rapidly from functional residual capacity during short intervals between strokes.

Although there is some standing around to play cricket, the player needs to be fit and strong. Cricket involves sprinting between wickets and running to stop balls, as well as bowling and throwing.

The present study suggests that regular exercise training has an important role to play in determining and improving pulmonary parameters. Therefore, regular swimming exercises in milder forms could well become a part of the rehabilitation program of patients with respiratory disorders. Exploration of the relation between physical activity and cardiovascular and respiratory functions will aid in understanding the mechanisms of how physical activity improves patient's quality of life and in finding a better way to evaluate the effects of rehabilitation.

One limitation of this study is that most of our healthy subjects were from mid to upper socioeconomic strata and only male sportsmen were included in the study. This shortcoming may affect the generalization of the results to other sections of society. This study was a cross-sectional study. A follow-up study with larger sample size is needed.

CONCLUSION

Pulmonary parameters of the sportsmen engaged in different branch of sports found to be higher than sedentary controls, and this shows that exercise training has a positive impact on the respiratory system. Furthermore, the differences that were found in PFTs among different sports branches have shown that sports branch has an impact on PFT.

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