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RESEARCH ARTICLE

Comparative study of pulmonary functions in swimmers and badminton players of Indore city

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ABSTRACT

Background: Exercise performed regularly is beneficial to the body. The previous studies in this field have shown that sportspersons have higher values of lung volumes in comparison to their control counterparts who are not engaged in any kind of regular physical exercise. Studies have shown that swimming produces the maximum effect on the lungs compared to any other sports. Nowadays, badminton is quite popular sports among younger as well as older generations. Badminton being a highly explosive sport involves a unique movement technique and strength over a relatively small court area. Regular practice of badminton has also a profound effect in improving pulmonary functions which can be comparable with that of swimming. **Aims and Objectives:** The purpose of this study was to evaluate and compare the pulmonary function in swimmers and badminton players of Indore city. **Material and Methods:** This study was carried out on 20 swimmers and 20 badminton players in the age group between 20 to 30 years. The pulmonary function tests (PFTs) were recorded with the RMS - HELIOS 702 spirometer. The parameters of PFT taken into account were forced vital capacity, forced expiratory volume in one second, and peak expiratory flow rate. The paired and unpaired *t*-test was used at appropriate places as a statistical test. $P < 0.05$ was considered statistically significant. **Result:** Increases in pulmonary functions were observed in swimmers as compared to badminton players. **Conclusion:** Even though swimming has a profound effect on improving the lung functions than any other sports, but badminton may be used as an alternative sport in improving the pulmonary functions when swimming is not feasible.

KEY WORDS: Swimmers; Badminton Players; Pulmonary Functions; Forced Vital Capacity, Forced Expiratory Volume in One Second, Peak Expiratory Flow Rate

INTRODUCTION

It is well known that pulmonary functions may vary according to the physical characteristics including age, height, body weight, and altitude. Regular exercise as in athletes produces a positive effect on the lung by increasing pulmonary capacity, and thereby improving the lung functioning.[1] Such exercises done regularly increases blood flow and increased nutrient delivery to these organs and improving their functions.[2] Cardiopulmonary system is no exception to these types of changes. Furthermore, regular physical activity improves muscle strength and aerobic capacity and decreases reaction time, and it also improves joint flexibility.[3]

It has been well documented in the literature that the person who has been engaged in any type of sports has higher values of pulmonary functions in comparison to their control counterparts who are not engaged in any kind of regular physical exercise.[4]

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Swimming is also no exception. Regular practice of swimming is considered to be a very good exercise for maintaining proper health and also has an effect in improving the pulmonary function of an individual. The purpose of choosing swimmers is that the previous studies have shown that swimming produces the maximum effect on the lungs compared to any other sports.[5]

Among the indoor games, badminton occupies the most preferred sports as an individual as well as team sports in spite of frequent changes that have occurred in various aspects of competition pertained to the game including fitness level, skills, strategies, and tactics.[6] And also, badminton has been an Olympic sport since the Barcelona Olympic Games in 1992. Playing badminton requires a constant analysis of the court, forcing the player to react precisely and quickly. Badminton players also have very short reaction time, and it may result from regular training and its effects such as better muscular coordination, improved concentration, and alertness to external environment on their bodies.[7]

Badminton is claimed to be the world's fastest racket sport, with the shuttle velocity following a smash being over 100 m/s and average shuttle velocity during match play ranging from 50 to 75 m/s.[8] To play badminton, you do not require a lot of investment, and nowadays, it is quite popular among younger as well as older generations. It just requires shuttle and cock, which can be easily available anywhere.

Badminton as a sport is very exhausting and makes use of almost every muscle in the body while running for the same amount of time burns half the calories. Between the running, lunging, diving, and ball hitting, playing badminton burns fat at approximately 450 calories per hour. This kind of cardiovascular workout can help keep you in tip-top shape, especially, if you are looking for a good alternative cross-training exercise.[9]

Previously, pulmonary functions of various sports such as basketball, hockey, football, and volleyball have been studied. And also, their comparison with that of swimmers has been studied. However, there is hardly any study done on the pulmonary functions of badminton players.

Hence, the purpose of this study is to investigate the pulmonary function of badminton players and comparison of the same with that of swimmers. Moreover, to find a specific exercise among these two which has maximum effect on the pulmonary functions.

MATERIALS AND METHODS

The present study was conducted on 20 healthy swimmers, who regularly swam a distance of 2-5 km, 6 days in a week for at least 6 months. Age, sex, height, and weight-matched 20 badminton players were taken, these players were playing daily for 1 h since 6 months.

They are in age range of 20-30 years. The experimental protocol was explained to them and written consent was obtained. All the procedures were non-invasive, and the study plan was approved by the Ethics Committee of Index Medical College Hospital and Research Center, Indore.

All the sportspersons included in the study were healthy and free from any cardiorespiratory ailments and were not on any medication. Sportspersons with the history of smoking, diabetes, and hypertension and the sportspersons suffering from chronic respiratory problems such as asthma and tuberculosis were also excluded from the study.

Moreover, their physical characteristics such as height, weight, and age, which have a role to play in determining the pulmonary functions, have been taken. Pulmonary function tests (PFTs) were recorded by RMS - HELIOS 702 made in India (Chandigarh) - a computerized spirometer.

The parameters of PFT included in the study were forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and peak expiratory flow rate (PEFR). All parameters were recorded during the morning hours 7.30-9.30 am. The sportspersons were made familiar to the machine and were taught its usage. After repeated practice of using the machine, their PFTs were recorded. The sportspersons were instructed to inhale and exhale normally, and then after taking a forced inspiration, they were asked to expire forcibly into the nozzle of the machine.

Three readings of all the tests were recorded and the best of the three was taken into account. Each of them was given half an hour rest before conducting PFT. Each subject was given two trials and three tests run for each test, and best of the three test readings was taken.

Statistical Analysis

The results of PFT are presented as mean ± standard deviation. The data were analyzed using student's *t*-test.

$P < 0.05$ was considered statistically significant.

RESULT

The PFTs were studied in 20 swimmers and 20 matched badminton players of Indore city that formed the study group. The range of age of volunteer student was from 20 to 30 years. The results were tabulated and statistically analyzed. To test whether there was any significant difference with reference to the study variables between the study groups, paired and unpaired *t*-test was used at appropriate places as a statistical test.

According to Table 1, FVC in swimmers was 4.18 ± 0.19 L and FVC in badminton players was 4.03 ± 0.18 L, and the difference between two was found to be statistically significant ($P = 0.01$). FEV1 in swimmers was 3.35 ± 0.15 L and FEV1 in badminton players was 3.23 ± 0.15 L. Moreover, the difference between two was found to be statistically significant ($P = 0.02$). PEFR in swimmers was 9.81 ± 0.35 L/s, and PEFR in badminton players was 9.71 ± 0.38 L/s. Moreover, the difference between two was not found to be statistically significant ($P = 0.40$).

DISCUSSION

The results discussed above clearly indicate that the swimmers had higher values of lung functions, i.e., FVC and FEV1 compared to that of the badminton players and the difference between them was also found to be statistically significant; however, the value of PEFR in swimmers and badminton players do not show any statistically significant difference even though the swimmers having higher value of it than badminton players. This clearly shows that regular exercise/practice of swimming has a profound effect in improving the lung functions. Similar results have been obtained by other workers in this field.[10-13]

This change could be attributed to the ventilatory stress that the swimmers have to endure. The possible explanation for this better lung functions could be manifold. Regular swimming practice may tend to alter the elasticity of the lungs and the chest wall which leads to improvement in the lung function of swimmers.[5] Swimming differs from the badminton in the following aspects[2]: (i) Swimming is performed in the horizontal position compared to the vertical position in badminton. (ii) The external pressure is higher as the density of the water is higher than that of air which is the usual external medium in other sports such as badminton. (iii) The ventilation is restricted in swimmers in every respiratory cycle for one moment or the others, producing a condition of intermittent hypoxia. This intermittent hypoxia sets up the anaerobic process during swimming. The lactic acid levels in the blood go on rising resulting in "lactic oxygen deficit".[14] This leads to the stimulation of the respiratory center in the medulla, therefore, increasing the respiration.

Table 1: Comparison of PFTs of swimmers (n=20) and badminton players (n=20)

Parameters	Swimmers (n=20)	Badminton players (n=20)	P value
FVC (L)	4.18±0.19	4.03±0.18	0.01*
FEV1(L/s)	3.35±0.15	3.23±0.15	0.02*
PEFR (L/s)	9.81±0.35	9.71±0.38	0.40

Data presented are mean±SD, *P<0.05: Significant, SD: Standard deviation, FVC: Forced vital capacity, FEV1: Forced expiratory volume in one second, PEFR: Peak expiratory flow rate, PFTs: Pulmonary function tests

There is also increased elasticity of the lungs and chest wall in swimmers that leads to improvement of lung functions in swimmers.[15] The ability of individual to inflate and deflate the lungs depends on the strength of thoracic and abdominal muscles, posture of individual, and elasticity of the lungs. Swimming increases this ability by number of factors.[16]

Hence, the respiratory muscles and the diaphragm of the swimmers are required to develop greater pressure as a consequence of immersion in water during the respiratory cycle, thus leading to functionally better respiratory muscles. These factors when combined together play an important role in developing better lung functions in swimmers compared to the other sportsmen.[2]

Greater lung size in swimmers and training of muscles of the shoulder girdle leads to an increase in the FVC by the increase strength of accessory muscles of expiration.[17] And also, during swimming, the external pressure is high; therefore, the respiratory muscles along with the diaphragm have to develop greater pressure for respiration.[5] This may lead to the improvement in the functional capacity of these muscles as it has been reported that specific training of ventilatory muscles increases the muscle endurance and also the capacity to sustain high levels of ventilation.[18] Hypoxia may also have a role to play. Moreover, this intermittent hypoxia faced by the swimmer due to restricted ventilation may lead to alveolar hyperplasia, thereby increasing the lung capacity.[13]

Badminton players must have great physical capacity, especially, agility, an aerobic strength, and explosive power.

Badminton being a highly explosive sport involves a unique movement technique and strength over a relatively small court area. It requires a coordinated functioning of the body and its reflexes.[6] Badminton is an intermittent sports activity characterized by long bouts of high-intensity exercise combined with rest periods. Badminton players are required to have a good stroke production and physical fitness, as well as physiological characteristics that will enable successful performance.[6] The badminton players with reference to anthropometrical, physical, and physiological characteristic results also revealed that they should be having more agility, more leg explosive power, more leg explosive strength, better height, better leg length, better arm length, better wrist girth, better breath holding time, and weight than the other sportsmen.[6] Moreover, due to all these things, badminton also having a profound effect in improving pulmonary functions.

CONCLUSION

Thus from this study, it clearly suggests that regular exercise training has an important role to play in determining and

improving lung volumes. Regular practice of swimming is having a profound effect in improving lung functions. However, as facility of swimming is not available everywhere, in such scenario, regular practice of badminton may be tried as an alternate exercise to improve the lung functions as it is also having very similar impact on lungs in improving their functions. Therefore, regular swimming exercises if possible, otherwise regular badminton practice, in milder forms could well become a part of the rehabilitation program of patients recovering from chronic obstructive pulmonary disease and other lung ailments.

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