

# Pulmonary Function Tests in Elderly Players Engaged in Indoor and Outdoor Game - A Comparative Study

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## ABSTRACT

**Background:** Any form of physical training when done regularly, is beneficial for health. Prolonged training results in the overall increase in muscular mass, metabolic power and strength which also includes respiratory muscles. The previous studies in this field have shown that sports persons have higher values of lung volumes in comparison to their control counterparts who are not engaged in any kind of regular physical activity. Constant and consistent exercises will improve the efficiency of a vital organ, our lungs, and that all either young or even elderly individuals need to work on this organ, along with rest of their body, for a healthier life. Enhancement of the respiratory muscle mass and strength can in turn result in increased respiratory efficiency which will be reflected in increased pulmonary function test values.

Now-a-days, badminton, one of the indoor games, is quite popular among younger as well as elderly individuals. Regular practice of badminton has a profound effect in improving pulmonary functions. Evidence also suggests that playing outdoor games one of which is cricket produces many health benefits which include endurance, stamina, balance and physical fitness.

**Aims & Objectives:** The type of sports and the training makes an individual to have an increase in pulmonary function test (PFT) parameters. Intensity and severity of sports performed by the subjects usually determines the extent of strengthening of the inspiratory muscles and the alveolar size with a resultant increase in the lung functions. These functional tests tend to have a relationship with lifestyle such as regular exercise and a sedentary life style. Hence, the present comparative study was undertaken to evaluate pulmonary functions in elderly badminton and cricket players, so as to establish a relationship between the type of sports and pulmonary functions and also to compare those with elderly sedentary individuals

**Material & Methods:** The study was carried out on forty (40) badminton players, forty (40) cricket players and forty (40) sedentary age, height, weight, sex matched elderly male individuals in the age-group of 40-60 years. Pulmonary function test (PFT) parameters like FVC, FEV1, FEF25-75% and MVV were recorded and studied.

**Data Analysis:** Unpaired 't' test was applied for comparing the parameters between the two groups.

**Results:** Highly significant increase in all the pulmonary function test parameters were observed in both, badminton and cricket players when compared with sedentary individuals. But, badminton players had highest pulmonary functions than cricket players.

**Conclusion:** As a conclusion, it was determined that respiratory functions were higher among the elderly individuals who are engaged in any sport activity either indoor or outdoor, when compared to those who were sedentary. Thus, the results indicate a positive effect of sports (physical activity) on the respiratory system even in elderly age-group. In addition to this the difference of pulmonary functions between different game players, show that a particular sports branch influences the respiratory system.

**Key Words:** Indoor Game, Outdoor Game, Elderly Badminton players, Elderly Cricket players, Pulmonary Function Test (PFT) parameters, Sedentary Elderly Males.

## INTRODUCTION

Our human body is an amazing machine, in which perfectly coordinated events will occur simultaneously. These events allow complex function such as hearing, seeing, breathing and information-processing to continue without one's conscious effort. <sup>(1)</sup>

As defined by World Health Organization (WHO), health is a state of complete physical, mental and social well being and not merely an absence of infirmity or disease. <sup>(2)</sup> We all know that exercise is important in our daily lives, but we may not know why or what exercise can do for us. It's important to remember that we have evolved from nomadic ancestors who spent all their time travelling large distances on a daily basis moving around in search of food and shelter. Our bodies are designed and have evolved to be regularly active. <sup>(3)</sup>

Exercises in different forms, if performed regularly, have a beneficial effect on the various systems of the body. The modality of exercise that is most beneficial and economic for masses has now become the topic of research. <sup>(4)</sup> But the increased demand of oxygen by the working muscles has to be met by the respiratory system which should adapt to the said status to satisfy the required oxygen. However, this increased level is limited, and the limits of the enlargement capacity of breathing muscles and chest wall and elasticity levels of bronchi lead to changes in that particular status. The amount of oxygen used by the muscles is directly proportional to the amount of energy they generate. The oxygen and carbon dioxide values are maintained at an appropriate level without increasing the load on the breathing muscles during the exercise. Heart rate increases to meet increasing oxygen demand, the energy used by the breathing muscles is decreased, and the signals that will increase the pulmonary functions tend to be minimized.

Due to these chain events, the exhaustion that is bound to occur otherwise in the breathing muscles is decreased; however, exercise performance is increased. The pulmonary capacity and functions of an individual are related to his body structure as well as the oxygen need of the sport or exercise performed by him.

The pulmonary volumes and capacities of the people differ (age, sex, body surface, exercise condition, athlete, and sedentary individuals). Certain lifestyle parameters such as smoking, lack of habitual physical activity, low physical fitness etc, can alter the lung functions. Alternately, having a physical fitness and good physical activity is said to have positive effect on lung functions. <sup>(5)</sup>

The Pulmonary function test (PFT) parameters are considered as important indicators of health in clinical research and an important tool for the assessment of respiratory function. PFTs determine the objective and quantifiable measures of the lung function. PFT aids in information about the small and large airways, the lung parenchyma, and the integrity, and size of the pulmonary capillaries. <sup>(5)</sup>

Badminton has been an Olympic sport since the Barcelona Olympic Games in 1992. 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.. 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.`

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. 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. <sup>(6)</sup>

Although cricket has origins in the British Empire, it is followed as a religion in South Asia, probably due to the influence of the former during their rule. The sport is equally popular among all groups of society, and is not subject to gender or age constraints. In various studies, cricket has shown to improve stamina and endurance. Most professional cricketers undergo rigorous training periods before they are considered fit to play. <sup>(7)</sup> The training that exercise form parts of the normal conditioning of these individuals help them attain endurance levels comparable to those of players from other, more intense sports. Cricket game has an impression that it is a relatively undemanding sport. However, cricket is a physically demanding sport and that cricket is a far consuming format, which requires the players to be athletic <sup>(8)</sup>.

The study conducted by A.K. Ghosh et al, on sportsmen playing different games including cricket showed significant increase in pulmonary functions. <sup>(9)</sup> There are several studies that have shown significant improvement in pulmonary functions as a result of the effect of exercise (10, 11). Sedentary life styles could be associated with less efficient pulmonary functions and regular competitive cricket practice could produce a positive effect on

the lungs by increasing pulmonary capacity and thereby improving the lung functions.

Previously, pulmonary functions of various sports such as basketball, hockey, football, and volleyball have been studied. However, the physical exertion due to prolonged training is different for different sporting activities because of the different muscle involvement and demand for oxygen. Hence, it is interesting to study the pulmonary functions of sportsperson of different disciplines and to find out and study the difference in the pulmonary function test parameters. <sup>(12)</sup> Even though cricket is one of the oldest organized sports, there are very few studies on pulmonary functions of elderly cricketers and badminton players.

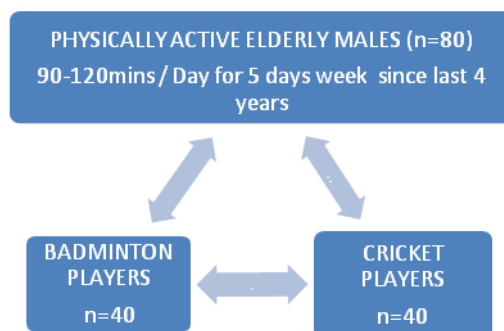
Hence, the purpose of this study is to investigate the pulmonary functions of elderly badminton players and comparison of the same with that of cricket players, moreover, to find a specific sport activity among these two which has maximum effect on the pulmonary functions in elderly players when compared with elderly sedentary individuals in accordance with new literature data.

## MATERIALS AND METHODS

Present study was conducted in the Pulmonary Function Test (PFT) Laboratory, Department of Physiology, Govt. Medical College, Aurangabad

**Study Design:** Case Control Study.

**Cases:** Eighty (80) elderly healthy physically active males, aged 40 - 60 years, were recruited as study cases. They were further divided as shown in the figure below.



**Controls:** Forty (40) Sedentary males were recruited as controls and care was taken that age, height, weight of the control was comparable and similar to the study cases. Matching with socio-economic status was done and none of the subject was engaged in any kind of regular physical exercise or sport activity. After explaining the purpose and design of the study, informed consent was obtained from all participants.

**Exclusion Criteria:-** All the study participants were clinically examined to rule out history of smoking, acute / chronic respiratory disorders, cardiovascular, hepatic or renal impairment and subjects with these ailments were excluded from the study.

## METHODOLOGY

Pulmonary functions were recorded on Whole Body Plethysmograph - Elite - Dx model (Med-Graphics USA make) PFT machine.

Spirometric parameters analyzed were Forced Vital Capacity (FVC), Forced

Expiratory Volume in the First second (FEV1), Forced Expiratory Flow (FEF25-75%), Maximum Voluntary Ventilation (MVV)

All the parameters were recorded on subjects sitting comfortably in up-right position and at Body Temperature and Pressure Saturated (BTSPS). The test procedure was done between 9 to 11 am for all the participants to avoid diurnal variations.

Percent (%) predicted values with respect to their characterizations as per the Breeze Suite Software for PFT were taken into consideration for statistical analysis to eliminate the effect of age, sex, height and weight on different parameters of pulmonary function.

**Statistical Analysis:-** Unpaired 't' test was applied for comparison between two groups.

## RESULTS

The findings of the present study are presented in Tables 1 and 2.

Table I : Demographic Variable

Parameter	Cases (Mean ± SD) BADMINTON PLAYERS	Cases (Mean ± SD) CRICKET PLAYERS	Controls (Mean±SD) SEDENTARY INDIVIDUALS
Age (Years)	49.88 ± 6.55	51.23 ± 1.11	50.22 ± 1.09
Height (Centimeter)	167.1 ± 4.7	165.2 ± 1.8	164.6 ± 7.1
Weight (Kilogram)	57.2 ± 3	59.02 ± 8.2	62.5 ± 9.2

Table II : Comparison of Percent (%) Predicted values of pulmonary functions in Elderly Badminton Players and Sedentary individuals.

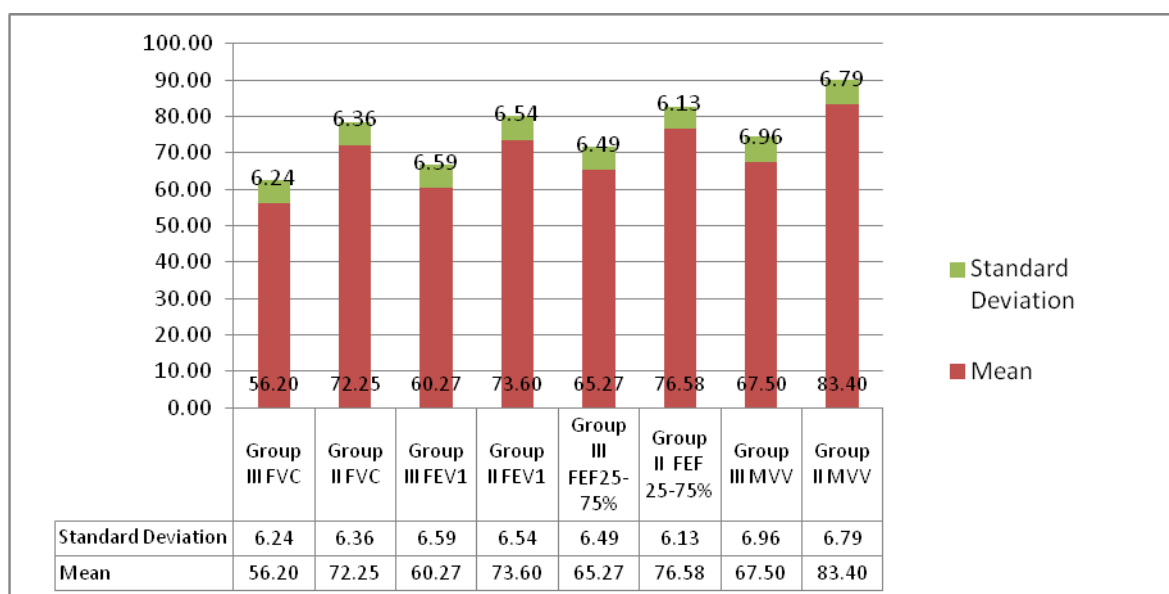
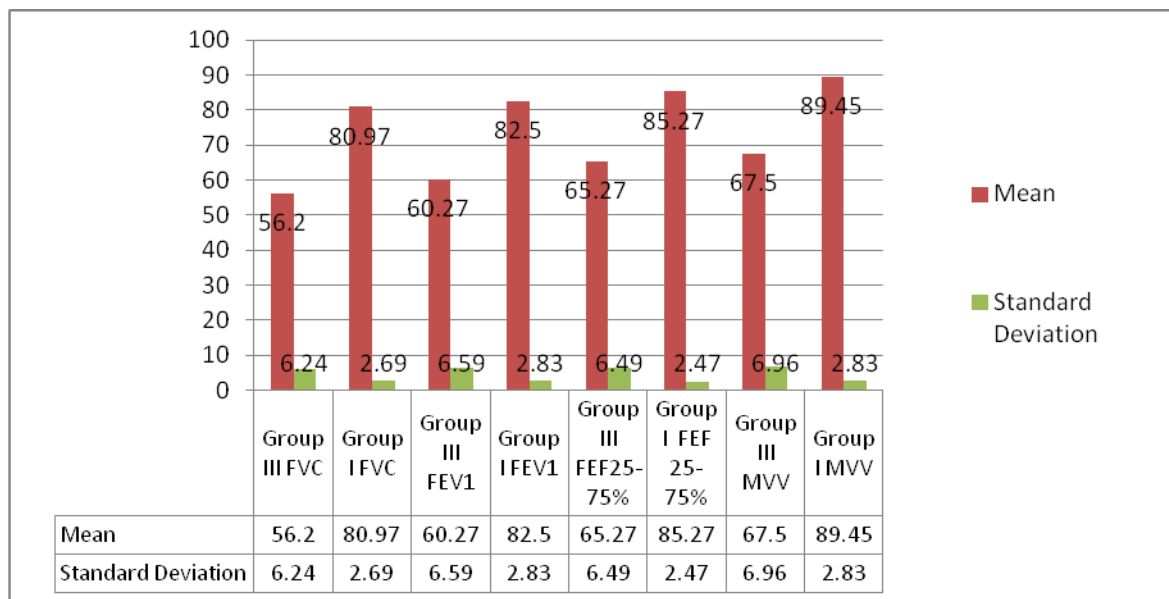
Lung Parameters	Test Group (Mean ± SD) BADMINTON PLAYERS	Control Group (Mean± SD) SEDENTARY INDIVIDUALS	'p' Value
FVC (%)	80.97± 2.69	56.2 ± 6.24	< 0.0001**
MVV (%)	89.45± 2.83	67.5 ± 6.96	< 0.0001**
FEV1(%)	82.5± 2.83	60.27 ± 6.5	< 0.0001**
FEF 25-75(%)	85.27± 2.47	65.27 ± 6.49	< 0.0001**

\*\* Highly Significant

Table III: Comparison of Percent (%) Predicted values of Pulmonary functions In Elderly Cricket players And Sedentary individuals

ung Parameters	Test Group (Mean ± SD) CRICKET PLAYERS	Control Group (Mean± SD) SEDENTARY INDIVIDUALS	'p' Value
FVC (%)	72.25± 6.36	56.2 ± 6.24	< 0.0001**
MVV (%)	83.40± 6.79	67.5 ± 6.96	< 0.0001**
FEV1(%)	73.60± 6.54	60.27 ± 6.5	< 0.0001**
FEF 25-75(%)	76.58± 6.13	65.27 ± 6.49	< 0.0001**

\*\* Highly Significant



## 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.<sup>(13)</sup>

This study has examined whether playing sports and the type of sports had an impact on PFTs in both players and sedentary-matched controls. Our study clearly shows that both the indoor and outdoor game elderly players showed highly significantly increased pulmonary function test values when compared with sedentary elderly individuals. In the present study, it is observed that there is significant increase in FVC, FEV1, FEF25-75%, MVV ( $p < 0.0001$ ) in elderly, indoor i.e. badminton players and elderly, outdoor i.e. cricket players than elderly sedentary individuals.

Muscular exercise increases the rate and depth of respiration and so improves

FVC the consumption of O<sub>2</sub>, and the rate of diffusion. <sup>(14)</sup> FEV<sub>1</sub> was also significantly high in both the sportsperson. This might have been brought about 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. <sup>(9)</sup>

MVV which depends both on the patency of airways and strength of respiratory musculature was significantly high in both the 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. <sup>(15, 16)</sup>

Pulmonary function is governed by genetic, environmental and nutritional factors and confirms that physical training during growth help in developing a greater endurance in respiratory muscles. Lung size may increase by a strenuous and prolonged strength training regimen during adolescence. <sup>(13)</sup> A continued high physical activity is associated with lower mortality and delays decline in pulmonary functions and therefore should be encouraged. <sup>(17)</sup>

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. 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. <sup>(6)</sup>

Cricket has been an established team sport for hundreds of years and is one of the most popular sports in the world. It originated in England and is now very popular in countries such as India, Sri Lanka, Australia, West Indies and South Africa. Competitive cricket is essentially a

bat and ball sport. It is played by two teams and involves batting, fielding and bowling. There are 11 players a side and a game can last anywhere from several hours to several days. Cricket matches come in three formats: test, one-day and twenty-twenty. The former is usually considered a trail of a player's psychological strength, whereas the latter two usually judge his corporeal strength.

During the span of one match, the bowlers, batsmen, fielders and the wicket-keepers are subjected to tremendous physical and even mental stress. For example, the bowler in this sport usually bowls from a variable run-up. This run-up may range from a few feet to several meters. Similarly, the batsmen have to judge the pitch of the ball, and then use his muscles to artistically divert it to his location of choice. He then has to crossover to the other side and completes a run. The fielders also have to remain vigilant throughout the course of the innings and once the ball finds their territory, have to run on to gather it and then throw it back. These, along with the boons similar to those associated with other strategic team sports, imply that each cricket game is an intense and involving experience, and every minute spent on the field requires an intricate balance between the mind and the body.

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. Moreover, due to all these factors, badminton game has a profound effect in improving the pulmonary functions. <sup>(6)</sup>

While in cricket, although there is some standing around, but to play cricket one has to be fit and strong. Cricket involves sprinting between wickets and also running to stop balls during fielding, as well as bowling and throwing. <sup>(18)</sup>

Keeping all these facts in mind the results of the present study can be correlated, which show that badminton players had higher pulmonary functions than cricket players.

## CONCLUSION

In conclusion, pulmonary functions in individuals who do exercise have been found to be higher than who do not. Pulmonary parameters of the sportsmen engaged in indoor (badminton) and outdoor (cricket) sports found to be higher than sedentary controls, and this shows that exercise training has a positive impact on the respiratory system. Indoor (Badminton) players had increased pulmonary functions than outdoor (cricket) players. Furthermore, this differences that were found in PFTs among different sports branches have shown that sports branch has an impact on PFT.

Exploration of the relation between physical activity and cardiovascular and respiratory functions will aid in understanding the mechanisms of how physical activity improves the quality of life even of an elderly individual. Playing a game either indoor or outdoor as per one's convenience may help to delay the age related decline of pulmonary functions even in elderly age group and thus promotes healthy aging.

## Limitations

- 1) However the present study has an important limitation of not comparing the effects of these sport activities on other body functions. Moreover, other factors like cost effectiveness and ability of any sport regime to keep continued, motivation and interest of the elderly individuals should be taken into account.
- 2) This study was a cross-sectional study, most of our healthy subjects were from mid to upper socioeconomic strata. This shortcoming may affect the generalization of the results to other sections of society.
- 3) Only elderly male sportsmen were included in the study.

- 4) Effect of indoor and outdoor air pollution is not taken into consideration while studying the pulmonary functions.

## Recommendations

Regular Physical activity causes many desirable physiological, psychological and physical changes in elderly individuals also. In developing and poor countries, the facilities for recreational sports and/or exercise are not easily available. Even low socio-economic group elderly individuals cannot afford to utilize them. In the past decades, however, the environment in which physical activity takes place has emerged as an additional element that can determine the activity's health benefit.

Cricket being one of the outdoor games weather conditions are the major limitations for daily practises. Also, some elderly individuals with physical constraints and for other reasons like lack of training and time may not be able to play cricket though they can play badminton instead. In light of these facts playing badminton daily, in milder forms for elderly sedentary individuals can become the most important way of lifestyle intervention for prevention of many diseases.

Thus lifestyle modification by including daily sport activity for better health in elderly sedentary population is suggested.

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