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Sports Specific Influence on Force Vital Capacity in University Players

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Abstract:
Objective: *The objective of this research was to study the pulmonary function in different types of sports and compare them with controls in order to find out which sports improve lung function the most.*
Methods: *This was a cross-sectional study involving 240 sportsmen of eight different games (30 of each): Basketball, Volleyball, Athletics (long & short distance Runners), Boxing (Fly to Middle weight boxers), Wrestling (57 to 86 kg), Swimming and Control group (Non-sportsmen).The Force Vital Capacity (FVC) was measured with Minispir® New, Computer–based Spirometer.*
Results: *The t – value of Force Vital Capacity (FVC) (L/S) for Non-Sports (M - 3.96±0.39) v/s Swimming (M - 4.68±0.55) was 5.65(p<0.001) and that of Non-Sports (M - 3.96±0.39) and Volley Ball (5.32±0.43) was 12.91(p<0.001). Similarly, the boxers, wrestlers and swimmers were found with significant better FVC in comparison to control group.*
Conclusions: *Our results suggest that the different sport activities performed ≥16 h per week have a significant impact on the physiological adaptation of the respiratory system.*
Keywords: *Force Vital Capacity; Athletes; Sports; Respiratory function tests.*

I. Introduction

According to World Health Statistics 2016 report, the 17 Sustainable Development Goals (SDGs) of the 2030, Health is centrally positioned, with one comprehensive goal (SDG 3) and its 13 targets covering all major health priorities, and links to targets in many of the other goals. WHO has predicted lifestyle-related chronic diseases – mainly cardiovascular disease, diabetes, cancer and chronic respiratory disease – will account for two thirds of all the deaths globally in next 25 years. Economic accountability as per WHO (2016) estimate between 2005 and 2015 will increase to around US – 558 ($) billion in China, 237($) billion in India, 303($) billion in Russia and 33 ($) billion in the U.K.

Physical inactivity is now identified as the fourth leading risk factor for global mortality. Physical inactivity, along with a sedentary lifestyle, is now a global 'non-communicable' disease. WHO (2010) Global Recommendations on Physical Activity for Health suggests that Adults aged 18–64 should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week. Physical activity is positively related to cardiorespiratory fitness in children and youth, and both preadolescents and adolescents can achieve improvements in cardiorespiratory fitness with exercise training Losnegard T et al. (2014) .

Pulmonary function tests (PFT) serve as a tool of health evaluation and also to some extent as a predictor of survival rate. PFT tend to have a relationship with life-style such as regular exercise and non-exercise Wassermann K et al. (1995). Pulmonary functions are generally determined by the strength of respiratory muscles, compliance of the thoracic cavity, airway resistance and elastic recoil of the lungs Cotes JE (1979) PFT provide qualitative and quantitative assessment of pulmonary function in patients with obstructive and restrictive lung diseases. Aerobic workout and other traditional physical activity like yoga and Tai Chi Chuan exercise can improve lung function in men and asthmatic children Chanavirut R et al (2006) & Chang YF (2008). Duration of exercise, its type and intensity also have effects on lung functions Losnegard T & Hallén J (2004), Galy O et al (2014).

The pulmonary function capacities of normal sedentary individuals have been studied extensively in India Aggarwal AN et al. (2000) but less in the context of comparison with different types of sports activities that are of a similar nature, according to the type and intensity of exercise performed, which could lead to the misclassification or misdiagnosis of certain respiratory dysfunctions. Furthermore, it is possible that highly trained athletes develop maladaptive changes in the respiratory system—such as intrathoracic and extrathoracic obstruction; expiratory flow limitation; respiratory muscle fatigue; and exercise-induced hypoxemia—that can influence their performance Losnegard T & Hallén J (2014). Moreover, some studies have reported positive adaptive changes in lung function in comparison with sedentary individuals MacAuley D et al.(1999). Forced Vital Capacity (FVC) is the ability in which lungs exhale maximum amount of air present and is a strong indicator of lung function, which decline due to sedentary life style Jakes RW et al (2002). The purpose of this study was to examine and compare pulmonary function through Forced Vital Capacity (FVC) in different types of sports that are of a similar nature, according to the type and intensity of exercise performed i.e. Basketball, Volleyball, Boxing, Wrestling, Athletics, Swimming and compare them with controls in order to find out which sports improve lung function the most.

II. Methodology

The present study was conducted on 240 subjects of eight different games (30 of each): Basketball (Age – 22.12± 2.67 & BMI – 21.32±1.62), Volleyball (Age – 23.01± 2.31 & BMI – 21.01±1.54), Athletics (Long Distance Runners) (Age – 23.62± 2.17 & BMI – 20.12±1.44), Athletics (Short Distance Runners) (Age – 21.32± 2.06 & BMI – 22.02±1.91), Boxing (Fly to Middle weight boxers) (Age – 22.62± 2.06 & BMI – 21.32±1.51), Wrestling (57 to 86 kg) (Age – 23.62± 2.17 & BMI – 20.12±1.44) Swimming (Age – 22.22± 2.37 & BMI – 22.02±1.37) and Control (Non-sportsmen) (Age – 22.19± 2.11 & BMI – 23.82±1.98). Only those players are selected in the sports category that represented their Universities/State (Haryana, India) in the All India Interuniversity/National in their respective sports discipline in 2016 and were engaging in that sport for ≥16 h per week. In non sportsmen category only those students were selected, who were pursuing their master's degree from Kurukshetra University and had never participated in any competitive sports. The Force Vital Capacity (FVC) was measured with Minispir® New, Computer–based Spirometer, Medical International Research S.r.l. -via del Maggiolino 125, 00155 Roma, Italy - P.IVA IT04564101006, USA - MIR Medical International Research USA.

III. Results

Table – 1: Analysis various (ANOVA) For Force Vital Capacity (FVC) Liters/seconds in the subjects of various categories

Sources of Variation	Sum of squares	df	Mean square variance	F. Value	P
Between Groups	65.970	7	9.42	33.23**	<0.001
With in Groups	77.71	274	0.28		
Total	143.68	281			

*** - significant at 1% level (P <0.01)*

For the Force Vital Capacity (FVC) L/S in the Subjects of various categories the F value is 33.23, which is more than the table value at 0.01 levels of significance. As F value is significant, it indicates that there exists significant difference within and between the all eight categories of subjects for Force Vital Capacity (FVC) L/S.

Table – 2: Significance of difference between Mean of Non-Sports persons and players of various Sports Categories for Force Vital Capacity (FVC)

Sr. No.	Categories	Mean of First Group	Mean of Second Group	S.E.D.	T-Value
1.	Non-Sports v/s Basket Ball	3.96±0.39	5.29±0.57	0.14	13.47**
2.	Non-Sports v/s Athletic (SDR)	3.96±0.39	4.23±0.57	0.15	2.04*
3.	Non-Sports v/s Athletic (LDR)	3.96±0.39	4.29±0.57	0.18	2.25*
4.	Non-Sports v/s Swimming	3.96±0.39	4.68±0.55	0.15	5.65**
5.	Non-Sports v/s Volley Ball	3.96±0.39	5.32±0.43	0.14	12.91**
6.	Non-Sports v/s Boxing	3.96±0.39	4.64±0.57	0.11	6.67**
7.	Non-Sports v/s Wrestling	3.96±0.39	4.66±0.40	0.13	7.06**

According to above table the significant difference in the means of Force Vital Capacity (FVC) between the non-sportsmen and sportsmen of various categories, it is indicated that mean Force Vital Capacity (FVC) of non-sportsmen and basketball is 3.96 and 5.29 respectively and the t-value is 13.47(p< 0.001, one tail test). Whereas, when FVC (L/S) of non-sportsmen (M - 3.96±0.39) and Athletes (Short Distance Race) (M - 4.23±0.57) were compared the t-value is found to be 2.04 (p< 0.021, one tail test). Similarly, the mean Force Vital Capacity of non-sportsmen (M - 3.96±0.39 L/S) and Athletes (Short Long Distance Race) (M - 4.29±0.57 L/S) with t – value 2.25 (p< 0.022, one tail test).

The t – value of Force Vital Capacity (FVC) (L/S) for Non-Sports (M - 3.96±0.39) v/s Swimming (M - 4.68±0.55) was 5.65(p<0.001) and that of Non-Sports (M - 3.96±0.39) and Volley Ball (5.32±0.43) was 12.91(p<0.001). Whereas, when the mean Force Vital Capacity (L/S) of Boxers (M - 4.29±0.57 L/S) and Wrestlers (M - 4.66±0.40) were compared with non sportsmen the t – value (one tail test) were 6.67 (p< 0.002) and 7.06 (p< 0.002) respectively.

IV. Discussion Of Results

According to results t - value for one tail test is found to be significant, when different categories were compared with the nonsportsmen i. e. Basketball - 13.47 ($p< 0.001$), Athletes (Short Distance Race) - 2.04 ($p< 0.021$),Athletes (Long Distance Race) - 2.25 ($p< 0.022$), Swimming - 5.65($p<0.001$), Volley Ball - 12.91($p<0.001$), Boxers - 6.67 ($p< 0.002$) and Wrestlers - 7.06 ($p< 0.002$). The results discussed above indicate that players of basketball, Volleyball, athletes (both LDS and SDS), Boxers and Swimmers who have at least represented university and state (Haryana) had higher values of FVC compared to the controls. It contrasts with previous reports which found that all athletes, regardless of the sport, had higher lung volumes than physically inactive persons Armour J et al.(1993), Mehrotra PK et al. (1998), Jakes RW et al.(2002), Janssen I (2009), Sable M et al.(2012), Shin YS et al. (2016).Mazic S et al. (2006) found that in Serbian elite 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. Shin YS et al. (2016) reported that the respiratory function of Korean wrestling athletes is better than that of non-athletes as analysis of the FVC graph revealed that the Korean wrestlers, athletes and the non-athletes were significantly different. The respiratory muscles of the athletes were anticipated to be better than those of the non-athletes.

In a cross-sectional study conducted by Myrianthefs et al. (2014), which included 276 athletes engaged in various sports, the results were similar to those obtained in our study. One possible explanation is that every sport differs in terms of the type and intensity of the exercise involved, which varies by season, as well as that there are sport-specific adaptations of body composition, a phenomenon known as “sport-specific morphological optimization” Berglund L. et al. (2011). Sabe M et al. (2012) swimming exercise affects lung volume measurements as respiratory muscles including diaphragm of swimmers are required to develop greater pressure as a consequence of immersion in water during respiratory cycle, thus may lead to functional improvement in these muscles and also alterations in elasticity of lung and chest wall or of ventilatory muscles, leading to an improvement in forced vital capacity and other lung functions of swimmers than runners. It is recognized that the respiratory muscles will adapt to aerobic training Losnegard T et al (2014). Most aerobic athletes have very well trained respiratory muscles from their sport alone. However, it is not known if additional respiratory muscle training could elicit positive adaptations within the aerobically trained athlete that would make the ventilatory process more efficient. During competition athletes will take thousands of breaths. Like all other skeletal muscles, the pulmonary muscles when engaging in aerobic metabolism require oxygen. The fatigue resistance of this process is related to the training status of the muscle. If the muscle is more endurance trained, then it will be less likely to constrain ventilation and exercise performance.

Akabas et al. (1989) an increase in aerobic enzymes during exercise in humans would equate to more efficient energy utilization of the respiratory muscles and lower fatigueability. Boutellier U et al. (1992) suggest resistance training offers some benefit to fatigue resistance in untrained students. The research also suggests that inspiratory muscles, like all other skeletal muscles, adapt according to the stress placed on them. William E et al.(2002) because the subjects had trained their pulmonary muscles, they were able to increase ventilation. The increase in Ventilation in L/min and decrease in Respiratory rate in the training group indicated that the Powerlung device increased the strength of the respiratory muscles. The increased strength of the respiratory muscles allowed the subjects to perform more work (i.e. move more air) while breathing fewer times.

As the lung volumes depend on height, higher values are expected in all tall athletes Laszlo (2006). We found higher value of FVC in basketball and Volleyball players, who were significantly taller than other sportsmen and controls. There was no difference in height among Wrestlers, Boxers, Athletes and swimmers , it would suggest that although height and age are the most commonly used predictive factors for lung volumes, other factors, thoracic diameter and trunk length, may predict lung volume in athletes. It is therefore likely that both anatomical and mechanical factors may account for differences in lung volume Cotes JE et al. (2001) & Lazovic B et al. (2015).Our results suggest that the type of sport has a significant impact on respiratory adaptation. Because of these sport-specific differences, there is a need for further investigations examining sports specific and exercise specific; the influence of the duration, severity, and intensity of exercise; the early years of training; respiratory muscle strength; and specific genetic influences.

V. Conclusion

This study agrees with previous reports and supports that regular exercise improves lungs functions. The study revealed that the sedentary subject's performance on FVC was poorer when compared with sportsmen who have been engaged in sports for ≥16 h per week and represented their Universities/State (Haryana, India) in the All India Interuniversity/National in Basketball, Volleyball, Boxing, Wrestling, Athletics and Swimming. Volleyball and Basketball players were having highest value of FVC. However, although the unique anthropometric characteristics of successful players of Volleyball and basketball have, as previously mentioned, been shown to be mostly attributable to genetic endowment, it remains unclear whether the superior lung function found in such athletes is due to genetic influences or to the specific pattern of exercise.

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