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A Comparative Study of Cardio Respiratory Efficiency between Aquatic and Track and Field Performers

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***Abstract*—**The present study was conducted to explore the basic pulmonary functions which may generally vary according to the bio-physical characteristics including age, height, body weight, and environment etc. of the sports performers. Regular and specific training exercises also change the characteristics of an athlete's prowess and produce a positive effect on the physiological functioning, mostly upon cardio-pulmonary efficiency and thereby improving the body mechanism. The objective of the present study was to compare the differences in cardio-respiratory functions between aquatics and track and field performers. As cardio-respiratory functions are influenced by pulse rate and blood pressure (systolic and diastolic), so both of the factors were also taken into consideration. The component selected under cardio-respiratory functions for the present study were i) FEVI/FVC ratio (forced expiratory volume divided by forced vital capacity ratio, i.e. the number represents the percentage of lung capacity to exhale in one second) ii) FVC1 (this is the amount of air which can force out of lungs in one second) and iii) FVC (forced vital capacity is the greatest total amount of air forcefully breathe out after breathing in as deeply as possible). All the three selected components of the cardio-respiratory efficiency were measured by spirometry method. Pulse rate was determined manually. The radial artery which is located on the thumb side of our wrist was used to assess the pulse rate. Blood pressure was assessed by sphygmomanometer. All the data were taken in the resting condition. 36subjects were selected for the present study out of which 18were water polo players and rest were sprinters. The age group of the subjects was considered between 18 to 23 years. In this study the obtained data inform of digital score were treated statistically to get result and draw conclusions. The Mean and Standard Deviation (SD) were used as descriptive statistics and the significant difference between the two subject groups was assessed with the help of statistical 't'-test. It was found from the study that all the three components i.e. FEVI/FVC ratio (p-value $0.0148 < 0.01$), FVC1 (p-value $0.0010 < 0.01$) and FVC (p-value $0.0067 < 0.01$) differ significantly as water polo players proved to be better in terms of cardio-respiratory functions than sprinters. Thus study clearly suggests that the exercise training as well as the medium of practice arena associated with water polo players has played an important role to determine better cardio respiratory efficiency than track and field athletes. The outcome of the present study revealed that the lung function in land-based activities may not provide much impact than that of in water activities.

***Keywords*—**Cardio-respiratory efficiency, spirometry, water polo players, sprinters.

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I. Introduction

RUNNING is the most natural of athletics movements. Several factors like heredity, environment, diet, training, socio-economic status, psychological trait etc. contribute to the performance of sportsman [1]. It ultimately improves the characteristics of different systems and organs of human body.

Improved function of every system is achieved by regular exercise. Thus it is evident from the studies that different systems and organs of an athletes, is developed by systematic training, and it is assumed that it has a positive effect on the respiratory system [2]. Running is not the only way to develop good pulmonary function. Swimming also assists to improve respiratory efficiency. In the game of water polo the different types of activities are involved. Such activities help to improve the inner and core physiological functionalities of an athlete. 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. Moreover respiratory system is an important system of a human body where gaseous exchange takes place with diffusion of enormous amounts of oxygen into the blood during physical activity [3].

It is well known that pulmonary functions may vary as per individual physical characteristics which include age, height, body weight, and altitude. Regular and systematic exercise produces a positive effect on the lung by increasing pulmonary capacity, and thereby improving the lung functioning [4]. It has been 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 [5]. Recent studies have shown that athletes have larger capacity of the respiratory system when compared to their age-matched sedentary controls. It was also observed that some particular sport disciplines improve the lung function better than others, these include swimming, and, as recently reported, basketball, water polo and rowing [6].

Water polo is a complex and physically demanding sport which consists of high power bursts of sprinting, interspersed with short time of low to moderate intensity swimming. This unique distinctiveness is one of the features of water polo [7]. Swimming produces the maximum effect on the lung function because it involves voluntary control of breathing. So, in comparison with other sprinting events, swimming has better positive influence on lung function [8].

Lung function parameters tend to have a positive

relationship with both field and aquatic events. Due to regular intervention of different training modules, both kinds of athletes tend to develop pulmonary efficiency [9]. Hence, a lung function test (spirometry) is the best predictor for both qualitative and quantitative evaluation of pulmonary function condition [10].

Pulmonary function can easily be detected with the help of Spirometry process. It is generally used to understand the different functional aspects of pulmonary function. Through the use of spirometry process the assessment and evaluation of respiratory problems can be identified. It will ultimately help to diagnose the problems associated with respiratory system [11]. Thus, spirometry is often considering as the best procedure for health monitoring procedure, especially for the sports persons who believed to have more sound physiological condition than sedentary people. The spirometry test results help to restrict the unnecessary risk of pulmonary ailment [12].

In the early studies, it has been reported that the training regium is very important for improvement of performances [10]-[12]. A good and scientific training helps an athlete to exhale his full performance potentialities during competition. This process is well supported by modern technology, newly invented equipment and surface areas. Compared to sprinting, swimming is another sporting event which tests a person both physically as well as mentally. Therefore the aim of this study was to compare the cardio-respiratory function on cross sectional samples such as water polo players and track athletes.

II. Objective of the Study

The objective of the present study was to compare the difference in cardio-respiratory functions between aquatics and track &field performers.

III. Methodology

Selection of the Subjects: 36 subjects were considered for the present study, out of which 18 subjects were from water polo event and rest were from track and field event, especially sprinters (100 mt. 200 mt. and 400 mt.). Each subject was having 2 to 3 years of training and they have also participated in qualified state tournament. The age group of the subjects ranged from 18 to 23 years.

Selection of the Variables: Age, height and weight were considered as personal variables. systolic & diastolic blood pressure, pulse rate and pulmonary function (namely FVC, FEV1 and FVCI/FVC) were considered as cardio-pulmonary variables.

IV. Results & Discussion

The collected data were recorded for statistical analysis in the form of digital score. In order to get the results from the raw scores Mean and SD were employed as descriptive statistics and in order to get results and to find exact differences between the groups, the 't' test was employed. Finally with help of significance level (0.05 & 0.01) the final conclusions were drawn.

TABLE I
Mean and SD of Age, Height, Weight of Subjects

Particulars	Mean		SD(±)	
	Aquatic Performers	Track Performers	Aquatic Performers	Track Performers
Age (yrs)	22.5	19.5	1.96	2.56
Height (cm.)	170.68	168.87	2.34	2.99
Weight (Kg.)	65.58	58.37	1.28	2.57

It was evident from Table I that mean score of age height and weight of aquatic performers were 22.5, 170.68 & 65.58 and SD of age, height and weight were 1.96, 2.34 and 1.28. It was also seen that mean age, height and weight of track performers were 19.5, 168.87 & 58.37 and SD of age, height and weight were 2.56, 2.99 and 2.57.

TABLE II
Blood Pressure Differences of Different Subjects

Particulars (mm of Hg)	Aquatic Performers		Track Performers		t – test ($p < 0.05$)
	Mean	SD(±)	Mean	SD(±)	
Systolic	122.33	3.13	123.78	2.53	0.734
Diastolic	80.33	2.48	82.44	1.93	0.180

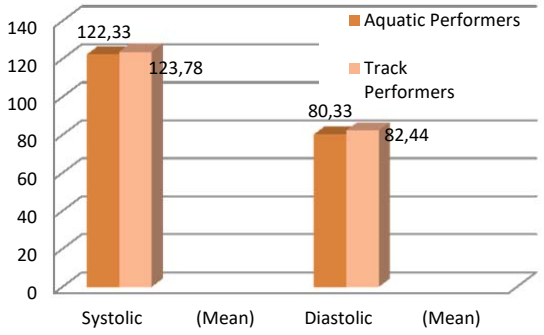

Fig. 1 Mean Blood Pressure Differences of The Subjects

Table II showed that the Mean and SD of systolic blood pressure of aquatic and track performers were 122.33, 123.78 and 3.13, 2.53 respectively. The mean and SD of diastolic blood pressure of aquatic and track performers were 80.33, 82.44 and 2.48, 1.93. Table II also showed insignificant result for systolic and diastolic blood pressure in between aquatic and track performers as the p value (0.734, 0.180) was greater than 0.05.

TABLE III
Pulse Rate of Different Subjects

Particulars	Mean	SD (±)	t – test ($p < 0.05$)
Aquatic Performers	74.22	1.96	0.4197
Track Performers	73.33	3.34	

Table III showed that the mean and SD of pulse rate of aquatic and track performers were 74.22, 73.33 and 1.96, 3.34 respectively. Table III also showed insignificant result for pulse rate between aquatic and track performers as the p value (0.41947) was greater than 0.05.

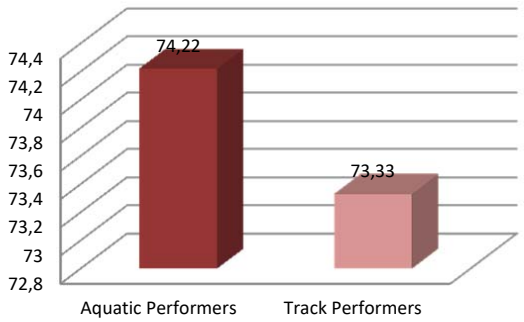

Fig. 2 Mean pulse rate difference of the subjects

TABLE IV
RESULTS OF PULMONARY FUNCTIONS OF DIFFERENT SUBJECTS

Particulars	Aquatic Performers		Track Performers		t – test ($p < 0.05$)
	Mean	SD(±)	Mean	SD(±)	
FVCI/FVC	92.03	2.21	88.34	2.68	.014811
FEV1	121.61	5.03	104.67	3.45	.00109
FVC	115.78	3.96	103.33	2.93	.006756

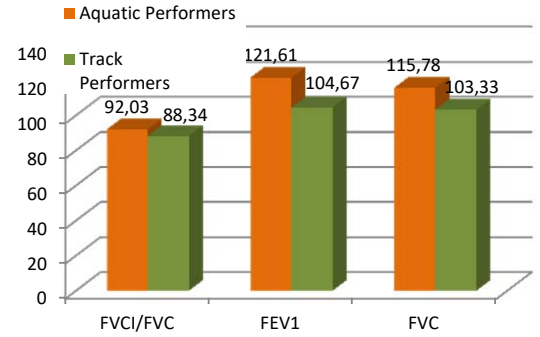

Fig. 3 Mean Pulmonary Functions of the Subjects

Table IV showed that the mean score of pulmonary functions of aquatic and track performers were 92.03 (FVCI/ FVC), 121.61 (FEV1), 115.78 (FVC), 88.34 (FVCI/FVC), 104.67 (FEV1), 103.33 (FVC) and SD of pulmonary functions of aquatic and track performers were 2.21 (FVCI/FVC), 5.03 (FEV1), 3.96 (FVC), 2.68 (FVCI/FVC), 3.45 (FEV1), 2.93 (FVC) respectively. From Table IV significant difference was found in pulmonary functions for all three components.

V. Discussion of Findings

Within the selected cardio-respiratory components the i) FEVI/FVC ratio (the number that represents the percentage of lung capacity to exhale in one second) ii) FVC1 (the amount of air which can force out of lungs in one second) and iii) FVC (the greatest total amount of air forcefully breathe out after breathing in as deeply as possible) are the primary components of spirometry measurements [13]-[15]. It was found from the study that all three components i.e. FEVI/FVC ratio (p-value 0.0148 < 0.01), FVC1 (p-value 0.0010 < 0.01) and FVC (p-value 0.0067 < 0.01) differ significantly between two subject groups. This clearly shows that regular practice of water polo has an intense effect in improving the lung functions. Similar results have been obtained by other workers in this field [16]-[19]. Regular intervention of swimming practice which is considered as best practice for water polo may lead to change in the elasticity of the lungs and the chest hedge which leads to improvement in the lung function of water polo players [20].

There are various studies that explain the cause of better pulmonary efficiency in water based sports. The general characteristics of the swimmers tend to be taller stature and greater biacromial diameter. Apart from these physical characteristics regular swimming also helps to build the elasticity of the lung function, increases the strength of intercostals muscles which leads to further improvement in lung function [21], [22].

VI. Conclusions

From the present study it was concluded that there was no significant difference found in case of systolic and diastolic blood pressure between aquatic and track performers and also an insignificant result was found in case of pulse rate. Finally, it was concluded that significant result was found in case of selected pulmonary functions between aquatic and track performers. From the present study it was very much evident that the exercise and training protocol adopted by the water polo performers in the bounded surroundings, proved to have better effect on cardio respiratory functions in comparison with selected track and field performers. It was also observed from the study that highly trained athletes proved to have better lung function. The present study has reported the same phenomenon that positive adaptive transformation in lung function tends to produce better output.

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