The Effect of Swimming on Pulmonary Function in Healthy Student Population

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Abstract

The effect of Swimming on the Pulmonary Function in healthy student population of 30 swimmers and 30 non-swimmers using Spirometry was evaluated in this study. The Pulmonary Function tests were carried out at the start of the swimming period and a second series of tests conducted at the end of 8-week period. Data collected was analyzed using‘t’-test. . $P < 0.05$ was considered significant and $P < 0.01$ highly significant. The results and conclusions drawn from them have also been highlighted where it was observed that incase of the study group, parameters like forced vital capacity (FVC), (forced expiratory volume in one second) FEV3, FEF25-75, FEF (Forced expiratory flow) 50%, FEF75% etc. were found significant increase which was not observed for most of the parameters in case of the control group.

KEYWORDS: swimming, PEFR, PEF, FEV3, FEF25-75, FVC, Pulmonary functions.

INTRODUCTION

It is a well documented fact that any sort of exercise done regularly, is beneficial for health. Swimming is no exception as considered to be a very good exercise for maintaining proper health and also has a profound effect on the lung function of participants. Regular swimming practice gives a positive effect on the lungs by increasing the pulmonary capacity and thereby improving the lung functions.

Pulmonary functions are generally determined by respiratory muscle strength, compliance of the thoracic cavity, airway resistance and elastic recoil of the lungs. It is well known that pulmonary functions may vary according to the physical characteristics including age, height, body weight, [3, 5, 6] and altitude (hypoxia or low ambient pressure).

Some physiological changes take place in the human body, when a person continuously swims. Swimming engages practically all muscle groups. Hence O2 utilization for the muscle is higher in swimmers. The water pressure on the thorax makes the respiration difficult. Breathing is not as free during swimming, as in most other types of exercise. Respiration during competitive swimming is synchronized with swimming strokes. Competitive swimmers require a high aerobic capacity to support the sustained performance of severe exercise, and the measurements of the maximal rate of oxygen uptake which a swimmer can sustain during exercise provide a useful index of physical fitness. The maximum oxygen uptakes of swimmers have been determined under various conditions; running [7, 8, 9].

The breathing (respiratory) muscles which are composed of the diaphragm, external and internal intercostals, parasternal, sternomastoid, scalene, external and internal oblique and abdominal muscles is the vital organ in mammals by which oxygen delivered to the red blood cells while concomitantly carbon dioxide removed and expelled into the environment as plays crucial roles during exercise. Since the athletes take thousands of breaths during the competition and similarly all other skeletal muscles, the respiratory muscles also need required amount of oxygen in order to work properly [1,2].

Pulmonary function testing plays a valuable role in evaluation and care of patients with various cardio respiratory disorders. It is used to evaluate respiratory symptoms, determine the severity of dysfunction, elucidate the pathophysiologic mechanism and assess the response to therapy. Pulmonary function test is done using a technique called Spirometry [11, 12]. The spirometer is an instrument that measures the amount of air breathed in and/or out and how quickly the air is inhaled and expelled from the lungs while breathing through a mouthpiece [4]. The measurements are recorded on a device called a spirograph. However, the pulmonary function test values vary with age, sex, height and weight.

There are various studies done with evaluating the effect of swimming on the pulmonary function in a healthy student population. Swimming is a demanding aerobic exercise that helps to keep heart and lungs healthy by the improved coordination of breathing and movement of the body, which also helps in expanding and strengthening of the lungs. Intensive swimming training enhances static and dynamic lung volumes and improves the conductive properties of both large and small airways [3].

The purpose of the present study was to see the effect of swimming on pulmonary function in the healthy students. The previous studies have shown that swimming produces maximum effect on the lungs compared to any other sport. Physical training is the ability to endure, to bear up, to withstand stress, to carry on in circumstances where an unfit person cannot continue and is a major basis for good health and well- being [9]. Exercise has been a means of testing the physical capabilities and physiological responses of an individual. Some health studies concluded that pulmonary function is a long term predictor of overall survival rates in both genders and could be used as a tool in general health assessment [10]. Exercise is a stressful condition which produces a marked change in body functions and lungs are no exception. Sedentary life styles could be associated with less efficient pulmonary functions. There are also several studies that have shown significant improvement in pulmonary functions as a result of the effect of exercise. However, there are studies which show non - significant change in pulmonary functions as an effect of exercise [9]. In this study, we have compared pulmonary functions of students, who pursue engineering course, before and after their training period and also compared with sedentary students of similar course. There are very few studies carried out to elicit the effect of physical training on the pulmonary function tests on the engineering students.

METHODOLOGY

Sixty students (pursuing engineering course) from Birla Institute of Technology & Science, Pilani were randomly selected for the study. Of which 30 students (15 girls and 15 boys) for an experiment group were selected from three hundred students who enrolled for swimming in the swimming club of the Institute while other 30 students selected for a control group from students who never participated in any kind of physical activities including swimming. The students for the experiment group practiced swimming regularly average of 5-3 times a week for a time of approximately 45 minutes while the students for the control group did not practice any exercise including swimming. All subjects were aged between 17 and 22 years and did not have a current or past history of smoking, respiratory diseases, and/or heart diseases

The spirometer (RMS Medispiror, made of Hclios 701) was used for the pulmonary function tests in the study. Questionnaires were given to all the subjects containing details like name; age; height; weight; body mass index (BMI); waist/hip ratio; family history of any disorder; lifestyle; allergies and any recent illness along with frequency of swimming with time period. Pre-tests were conducted at the start of the semester (when subjects started swimming) in the month of August and the tests were repeated after a 2-month period.

The parameters taken into account in this study were Forced Vital Capacity (FVC), Peak Expiratory Flow Rate (PEFR), Forced Expiratory Volume in one second (FEV1), Forced expiratory flow (FEF). A comparative study of all these parameters was done between the two tests to see whether there was any effective change in lung volumes due to swimming. All the information was statistically analyzed using SPSS software (17.0 versions). Obtained data was analyzed using one way analysis of variance (ANOVA).P< 0.005 had taken as statistically significant. The data collected from the Pulmonary Function tests of the 30 swimmers and 30 controls was analyzed and the "t-test "was performed. Statistical analysis was done for all the parameters. 'P' value was determined. P>0.05 was considered as non-significant. Independent student t test was used for between groups comparison. Data obtained was fed to the computer and analyzed and valid conclusions were drawn.

RESULTS

The values for the Means and Standard Deviation for all parameters have been listed below in Tables 1 and 2. The spirometric parameters were compared for significance in difference, using Student's t-test. P < 0.05 was considered significant and P < 0.01 highly significant.

Table 1. **Comparison of Parameters in Test subjects before and after swimming:**

INDICES	PRE VALUE		POST VALUE	
	MEAN	SD	MEAN	SD
FVC*	3.26	0.717	3.39	0.766

FIVC**	1.68	1.16	0.28	0.344
FEV.5	2.37	0.49	2.37	0.49
FEV1	3.04	0.63	3.06	0.67
FEV3*	3.26	0.73	3.38	0.76
PEFR	7.23	1.92	7.14	1.7
PIFR***	2.13	1.53	0.82	1.03
FEF25-75**	3.97	1.02	3.69	1.03
FEF75-85**	1.82	0.63	1.57	0.602
FEF.2-1.2	5.7	2.18	5.92	1.82
FEF25%	6.56	1.7	6.52	1.38
FEF50%*	4.38	1.16	4.12	0.92
FEF75%**	2.25	0.72	2.02	0.71
FEV.5/FVC*	73.08	8.34	70.40	6.63
FEV1/FVC**	93.82	6.17	90.58	6
FEV3/FVC	100.09	1.38	99.53	1.37

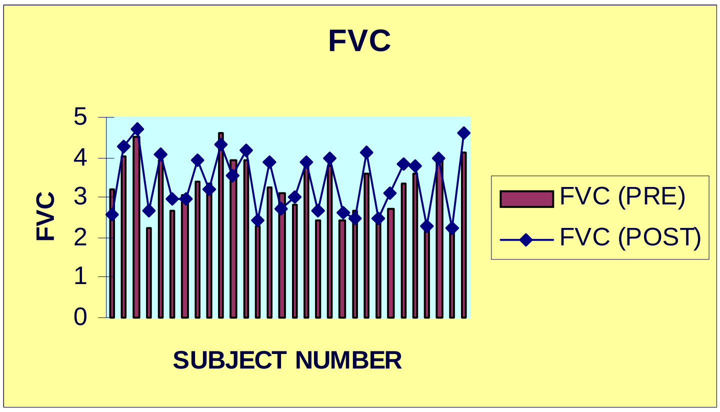
* P < 0.05, ** P < 0.01, *** P < 0.001, n = 30, Student's t-test

Table 2: **Comparison of Parameters in control group at Day 1 and Week 8:**

INDICES	DAY1 VALUE		WEEK8 VALUE	
	MEAN	SD	MEAN	SD
FVC	3.12	0.577	3.01	0.53
FIVC*	1.15	1.27	0.27	0.24
FEV.5	2.23	0.36	2.30	0.45
FEV1	2.89	0.52	2.90	0.47
FEV3	3.11	0.58	3.06	0.50
PEFR*	6.33	1.18	7.05	1.38
PIFR*	1.61	1.82	0.59	0.79
FEF25-75	3.69	0.82	3.94	1.18
FEF75-85	1.72	0.64	1.90	0.79
FEF.2-1.2	5.27	1.41	5.77	1.80
FEF25%	5.94	1.11	8.80	13.71
FEF50%	4.10	0.95	4.44	1.35
FEF75%	2.13	0.65	2.28	0.82
FEV.5/FVC	71.9	6.96	75.60	10.29
FEV1/FVC	93.04	5.60	93.78	5.74
FEV3/FVC	99.71	2.24	96.87	18.06

* P < 0.05, n = 30, Student's t-test

The general trend showed that baseline values for parameters such as FVC, FEF25-75, FEF 50% etc. was lower before swimming as compared to after 8 weeks.



DISCUSSION

The results from Table-1.indicate that the parameters such as FVC, FEV3, FEF50% and FEF.5/FVC ($p < 0.05$) have a significant increase in values after the 2-month swimming period. Also, for parameters like FIVC, FEF 25-75, FEF 75-85, FEF 75% and FEV1/FVC ($p < 0.01$) there was a highly significant increase in the post swimming value whereas FEV1, FEV.5, PEFR and FEF.2-1.2 ($p > 0.05$) showed no significant increase. The values for the control group comprising of non-swimmers did not show any significant increase for most of the parameters when compared to the swimmers. Parameters such as FIVC, PEFR and PIFR ($p < 0.05$) showed significant increase. These significant increases maybe correlated with the effect of swimming on the static and dynamic lung volumes of the test subjects. Since there was least amount of significance in case of the control, this could be due to not swimming or exercising in the 8-week period. Thus we are able to show that the significant increase in most of the parameters for the study group maybe directly related to the swimming.

Conclusion

This may be concluded from this study that the 8-week practice of swimming increases pulmonary function significantly. Pulmonary function denotes that how well the lungs take in and exhale air and how efficiently they transfer oxygen into the blood. Spirometry measures how well the lungs are functioning. Regular swimming produces a positive effect on the lung by increasing pulmonary capacity and thereby improving the lung functioning. Good swimmers tend to be above average for lung capacity. Training during adolescence increases vital capacity and total lung capacity due to the development of a broad chest and long trunk and this increased vital capacity helps swimmers maintain their buoyancy. The information gathered during this test is useful in diagnosing certain types of lung disorders such as Bronchial Asthma and, chronic obstructive pulmonary disease, COPD). So, the authors suggest that a regular practice of swimming increases pulmonary function, and this may help a regular swimmer be less likely to develop chronic obstructive pulmonary diseases and also have a better control on Asthma.

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