

## COMPARATIVE STUDY OF DYNAMIC PULMONARY FUNCTION TESTS IN SWIMMERS AND CONTROLS

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### Abstracts:

**BACKGROUND** - Regular exercise brings about many changes in the body thereby enabling lungs to function more positively. Swimming is one such exercise that helps training the body to use oxygen more efficiently, which can be seen over the period of time in their declining trends of resting heart rate and breathing rate. Diaphragm being the main muscle of tidal respiration is under great pressure in water at the time of respiratory cycle which improves its strength and flexibility. Hence there is an improvement in FVC and other PFT Parameters of Swimmers. **AIMS AND OBJECTIVES** - To investigate and report pulmonary function of swimmer and compare these values with the pulmonary function of healthy adults of same age group not routinely engaged in any specific exercise. **MATERIALS AND METHODS** - In this Study, Pulmonary Function Test (PFT) was performed on 60 male adults between 18 to 30 years of age, in which thirty were swimmers having the experience of at least 6 months of regular swimming. These were compared with thirty controls of same sex and age group with sedentary life style. Lung Function parameters were recorded using SpiroExel Software and PFT Machine and results were thereafter analysed statistically. Any Respiratory disorder was ruled out by carefully examining all the subjects clinically before the start of study. **RESULTS AND CONCLUSION** - At the end of this study, it was found that FVC (%) and FEV1 (%) were significantly improved in Swimmers (P VALUE 0.000001 and 0.0001 respectively). Although the difference in FEV1/FVC (%) was found to be insignificant (P VALUE 0.836), improvement in PEFR (%predicted) showed statistical significance (p value 0.00007). Thus concluding that Vital capacity, elasticity and air flow of lungs improves over the period of time in swimming and this may be induced in the exercise programme for betterment of respiratory patients with impaired lung functions.

**Key Words:** Swimmers, Pulmonary function, PFT, FEV1, FVC%, FEV1/FVC, PEFR.

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### Introduction:

Swimming strengthens the body, helps relax the mind, regulates breathing and it stimulates circulation.

Increased practice of swimming is known to bring about significant enhancement of larger airway caliber estimated in terms of peak expiratory flow rate (PEFR), forced expiratory volume during first second (FEV1), also caliber of small airways as measured by maximum mid expiratory flow volume (MMEF) and lung capacity estimated via forced vital capacity (FVC%).

The response to swimming may be expected to be different from the response to many other types of man's activities due to following reasons:-

1) The swimming is performed in horizontal position compared to vertical position in other sports.

2) The external pressure is higher as the density of the surrounding medium is higher than that of air.

3) Heat conductance of water is higher than that of air.

Swimmers are known to have above normal spirometry and higher pulmonary diffusion capacity as an additional hydrostatic pressure that surrounds the thoracic cavity while swimmers are immersed in water presents an additional load which must be overcome by the inspiratory muscles in order to generate inspiratory airflow to the lungs.

The ventilation is restricted in every respiratory cycle for one moment or the other, 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".

This leads to the stimulation of respiratory center in the medulla thereby increasing the respiration.

Further, restricted ventilation experienced during swimming leads the swimmer to face intermittent hypoxia that result in alveolar hyperplasia therefore increasing vital capacity and FVC.

The ability of individual to inflate and deflate his lungs depends upon the strength of the thoracic and abdominal muscles, posture of individual and elasticity of lungs.

Swimming increases this ability by number of factors. It involves keeping the head extended which is a constant exercise of the erector spinae muscle and increases the vertical and Anteroposterior diameter of lungs.

Besides supraspinatus, trapezius, sternocleidomastoid and diaphragm are also being constantly exercised.

Co-ordination between the movement of ribs and various groups of muscles makes swimming an endurance exercise and overcoming the resistance offered by water makes swimming a resistance exercise.

Hence, swimming forms a unique sporting activity wherein both endurance and resistance form of training is imparted which enables to enhance the muscular strength.

**STROKES OF SWIMMING:** 4 major strokes performed worldwide are:-

- FREE STYLE/FRONT CRAWL

-Generates the greatest force

-Fastest among four

-Engages chest,lateral and back muscle

- BACK STROKE

-Perfect for recovery after intense workout.

-Improves posture

-Engages back and hamstrings

- BREAST STROKE

-Good strengthening and cardiovascular workout.

-Engages shoulder,chest and lateral muscle.

-Slowest.

- BUTTERFLY

-Good for fat burning and boosting metabolism.

-Engages chest,back,core and shoulder muscle.

-most tiring.

### Materials and Methods:

This study was conducted on 30 male swimmers and 30 healthy male volunteers as control in the age group of 18-30 years.

The swimmers were selected from Dolphin Health and Fitness club, Shahibaugh, Ahmedabad.

Controls were healthy male volunteers not routinely engaged in any specific exercise.

Instrument used was Spiroexcel digital spirometer by Medicaid systems at physiology department of BJ Medical college,Ahmedabad.

### INCLUSION CRITERIA –

- Subjects with body mass index between 18.5 to 22.99
- Swimmers with 40 minutes of practice daily for atleast 6 consecutive months.

### EXCLUSION CRITERIA –

- Subjects who were practicing aerobic exercises or yoga.
- Users of tobacco in any form.
- Patients with known history of acute or chronic respiratory infections.
- Patients with gross abnormalities of vertebral column or thoracic cage.
- Patient with any neuromuscular disease or malignancy.
- Subjects who have undergone major abdominal or chest surgeries.

Basic parameters of subject like age, weight and height were recorded to obtain the predicted values in spirometry.

The subjects were made familiar to the machine and were taught its usage.

Pulmonary function test was performed in sitting posture facing opposite to the PFT monitor.

Spirometry was done using spirometer three times and best of the three value was considered.

Like this flow volume loop and volume time curve was obtained for each and every subject.

### Result:

Variables recorded were:-

- Forced vital capacity(FVC)
- Forced expiratory volume during first second(FEV1)
- FEV1/FVC Ratio
- Peak expiratory flow rate(PEFR)

LUNG FUNCTION PARAMETER	STUDY GROUP (n=30)	CONTROL GROUP (n=30)	P VALUE	RESULT
	MEAN± SD	MEAN ± SD		

FVC (%)	84.46± 12.83	67.44± 13.90	1.227* 10 <sup>-6</sup>	Signi fican t
FEV1 (%)	89.92± 18.06	71.82± 15.78	1.48* 10 <sup>-4</sup>	Signi fican t
FEV1/FVC (%)	110.56 ±13.46	109.89± 10.84	0.836	Insig nific ant
PEFR (% PRED)	104.77 ±18.30	85.7± 15.78	7*10 <sup>-5</sup>	Signi fican t

**Discussion:**

Student t test was used to find the difference in spirometric parameters between healthy control and swimmers

P value of <0.05 was considered significant.

In this study, we found statistically significant difference in FVC% (P Value-1.227\*10<sup>-6</sup>) of swimmers as compared to healthy controls which shows that swimming improves overall Lung capacity due to continuous exertion involved which improves elasticity of lung and chest wall over time.

We also found out statistically significant improvement in FEV1(P Value- 1.48\*10<sup>-4</sup>) and PEFR(P Value-7\*10<sup>-5</sup>) in Swimmers as compared to controls which goes on to indicate that swimming increase the calibre of airways by developing physically wider chests containing an increased number of alveoli rather than the alveoli of increased size.

However, the increase in FEV1/FVC% was not found to be statistically significant(P Value-0.836) in swimmers compared to controls as the training of muscles of shoulder girdle while swimming leads to an increase in the vital capacity by reason of increased strength of accessory muscles of inspiration. This change is not accompanied by corresponding increase in FEV1, so the proportion of FVC which these subjects can expire in first second tends to be relatively low.

**Conclusion:**

The result of this study support the idea that swimming has facilitative effect on ventilatory function and swimmers have improved lung function values in comparison to sedentary person.

Within the limitation of our study, we can conclude that unlike specific weight training exercises or running, swimming benefits the upper body, torso and legs together.

It will improve general strength, Lung Capacity, stamina and cardiovascular fitness.

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