National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

A comparative study of pulmonary function tests in swimmers and sedentary control persons of Ahmedabad

Devanshi Upadhyaya[1], Rachit Joshi[2]

[1]Department of Physiology, Ahmedabad Municipal Corporation Medical Education Trust Medical College, Ahmedabad, Gujarat, India, [2]Department of Physiology, B.J. Medical College, Ahmedabad, Gujarat, India

Correspondence to: Rachit Joshi, E-mail: drrachitjoshi@gmail.com

Received: March 08, 2019; **Accepted:** March 28, 2019

ABSTRACT

Background: Regular exercise in any form has been found beneficial to human body. Swimming is a kind of exercise which not only involves the overall body muscle actions but also relaxes the mind with a specific positive action on respiratory system. **Aims and Objectives:** This study aims to find out the benefits of swimming on respiratory system and reaffirm the fact that there is an improvement of pulmonary functions with regular swimming. **Materials and Methods:** In this regard, we carried out a comparative study on pulmonary function tests (PFTs) in swimmers of Ahmedabad city along with the persons of sedentary lifestyle. PFTs were carried out using RMS Helios 702 portable PFT machine. The data obtained were compiled, statistically analyzed, and compared with the control group. **Results:** Our results showed statistically significant higher lung volumes and flow rates in the swimmers than sedentary person. **Conclusion:** Swimming is advisable exercise to improve respiratory efficiency.

KEY WORDS: Swimming; Pulmonary Function Test; Respiratory Efficiency; Sedentary Person

INTRODUCTION

Regular exercise performed religiously has a beneficial effect on different systems of our body. Swimming is a unique kind of exercise and a sport which is carried out in a different environmental condition than other forms. The effect of gravity, shifting of the center of mass of human body, and the buoyancy of water play a major role. Human body by achieving muscular efficiencies naturally accomplishes this act of swimming.[1]

Swimming is a low-intensity exercise of long duration which produces increase in the number of mitochondria in the skeletal muscle fibers that are used in it. Along with it, there is increase in the number of blood capillaries around them. All such changes lead to enhanced capacity for endurance activity with least of fatigue.[2] Mehrotra *et al.* studied the pulmonary function tests (PFTs) on various types of sports person and found that out of all types of sports person swimmers have better values of pulmonary function.[3] Swimming differs than other sports activity due to horizontal position of the body, higher amount of humidity, restricted ventilation underwater, and increased external pressure. Heat loss from the body is also very fast due to higher specific heat and conductivity of water. The pressure exposed to diaphragm is also greater during swimming than running.[4] Lung functions and capacities are determined by the respiratory muscle strength, elastic recoil, airway resistance, and compliance of lung and thoracic cavity. As many previous studies have showed greater respiratory function is swimmer our aim was to find out the advantage of swimming on respiratory system and to reaffirm the fact that by doing regular swimming lung functions can be improved and swimming can be used as relaxing mode of rehabilitation for some of the respiratory disorder patients.

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2019.9.0309728032019	

MATERIALS AND METHODS

In the present study, 30 subjects selected were residents of Ahmedabad city who had been swimming for the past 2–6 years or more, who routinely performed for 2–3 h a day for minimum of 5 days a week. The study was carried out at the Eklavya sports complex situated at Thaltej, Ahmedabad, before starting their routine warm-up before swimming,[5] i.e., in resting state. The control population was represented by untrained persons. We took the permission of ethical committee to carry out our study before beginning.

All the participants were male whose age was between 21 and 49 years. The purpose and importance of the study was explained to them. Only those who were ready to take part willingly with written consent and were without any of the diseases such as diabetes mellitus, hypertension, ischemic heart disease, tuberculosis, and asthma; not even in their family was selected for our study. Persons having addiction of alcohol and tobacco were rejected. They were not suffering from any kind of disease and were not on any kind of drugs. Similarly, 30 males of same age group of Ahmedabad city were chosen as controls who did not carry out regular sports activity or daily exercise such as yoga, running, cycling, and walking. Proper clinical examination and anthropometric measurements were taken before starting the PFTs to avoid human error. All the subjects and controls were made aware of the methods and the functioning of the instruments. They were given trials to reduce their apprehension and for smooth functioning of tests. Respiratory parameters were recorded during the morning hours of 8 am–10 am in the month of September–October 2015 to avoid diurnal variations. To avoid instrumental errors, we carried out the same tests on all the participants with the same instrument.

The PFTs recorded in the study were as follows:

- Forced vital capacity (FVC) in liters.
- Peak expiratory flow rate (PEFR) in liters/second.

Spirometry was performed in sitting erect posture with a computerized portable PFT machine HELIOS 702 version 1.0.13 made by RMS company. After the demonstration of method, subject was allowed to rehearse. The subjects were instructed to perform following maneuvers in succession.

One deep forceful complete inspiration followed by a forceful as fast as, as complete as possible expiration.

Graphic values and flow-volume loops were obtained. Subjects were given three attempts of similar test; of this best attempt with a perfect, flow-volume loop was selected. The data were obtained through computer printer. We analyse the data was analysed using unpaired *t*-test and only that result was consider statistically significant where $P < 0.001$.

RESULTS

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

DISCUSSION

Results of our study showed FVC of 3.24 ± 0.62 and 2.43 ± 0.49 l and its percentage of predicted value 96.1 ± 11. 00 and 67.95 ± 10.4. PEFR obtained was 8.16 ± 0.82 and 5.83 ± 1.6 l/s and its percentage of predicted values 91.43 ± 13.92 and 65.46 ± 18.5 in swimmers recruited and control subjects, respectively. Hence, from this result, we can confirm that swimmers have significant higher values of pulmonary function than their sedentary counterparts.

Similar result of higher lung functions was obtained in the study of different sports person of India carried out by Mehrotra *et al*.; they showed that by doing regular exercise, there is proven benefit to the human body and the lungs are one of them.[3] They attributed it to release of pulmonary surfactant and increase in prostaglandin into the alveolar space which increases the compliance of lung and decreased smooth muscle tone in bronchial tree due to maximal and prolonged inflation and deflation. Our results were in concurrence with the study on swimmers carried out by Akhade and Muniyappanavar associate who suggested that increase in pulmonary functions could be due to increased muscle strength of respiration in them.[5] Similar results were found in swimmers of different cities such as Lucknow[6] and Amritsar.[7] They have explained it on the basis of improvement in strength of respiratory muscle, thoracic mobility, and better balance between lung and

Table 1: Mean and standard deviation values of age (years), height (cm), and weight (kg) of swimmers (*n*=30) and control subjects (*n*=30)

Parameters	Swimmers		Sedentary	
	Mean±(SD)	Range	Mean±(SD)	Range
Age (years)	35.83±(7.38)	21–49	36.93±(8.7)	20–48
Height (cm)	170.73±(8.05)	151–186	172.26±(5.99)	157–184
Weight (kg)	77±(12)	56–105	77.43±(11.9)	59–110

SD: Standard deviation

Table 2: Mean and standard deviation values of respiratory functions in swimmers (*n*=30) and sedentary persons (*n*=30)

Parameters	Swimmers	Sedentary	*P*-value
	Mean±(SD)	Mean±(SD)	
FVC (lt)	3.248 (0.62)	2.43 (0.49)	<0.0001
% Pred. FVC	96.1 (11.00)	67.95 (10.4)	<0.0001
PEFR (lt/s)	8.16 (0.82)	5.83 (1.6)	<0.0001
% Pred. PEFR	91.43 (13.92)	65.46 (18.5)	<0.0001

FVC (lt): Forced vital capacity in liters, % pred. FVC =% of predicted FVC, PEFR: Peak expiratory flow rate (l/s) and % pred. PEFR = % of predicted PEFR. Value of $P<0.001$ (High significant)

chest elasticity gained from training in swimmers.[8] Joshi and Joshi on their study on forced breathing found improvement in PFTs. They suggested that the practice of forced breathing without breath holding can increase the strength of respiratory muscles and increase the elastic properties of lungs and chest, thus leading to the improvement of ventilatory functions of the lungs.[9] Armour *et al*. contradicted the above suggestion in different studies but suggested that elite swimmers develop over a period of time physically wider chest with an increase in number of alveoli but not increase in their size.[8] Our result was in concurrence with other studies on swimmer carried out at different times, carried out on different sports person and particularly on the swimmers of different cities.[10-14] Warm-up exercise before swimming for 25–45 min also improves the pulmonary functions for swimmers.[13]

Our study was able to perform according to our aims and objectives. There was a significant improved pulmonary function in the swimmers of Ahmedabad city. However, ethnic, genetic, climatic, social, mental, and various other conditions also play a significant role in the performance and outcome of the test.[8,15] Hence, to confirm the positive effect of swimming, we must carry out and synchronize the multiple studies at multiple sites.

CONCLUSION

Our study reaffirms the fact that regular activity like swimming has a beneficial effect on the PFTs which can be of help to improve some of the respiratory disorders.

ACKNOWLEDGMENT

We are thankful to the Department of Physiology, AMC MET Medical College, Ahmedabad, for their support at every step of the study. We also wish to thank authorities of Eklavya sports complex for allowing us to use their premises for this study. We are also grateful to our subjects for their active participation and helpful nature without which this study would not have been completed.

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How to cite this article: Upadhyaya D, Joshi R, A comparative study of pulmonary function tests in swimmers and sedentary control persons of Ahmedabad. Natl J Physiol Pharm Pharmacol 2019;9(6):527-529.

Source of Support: Nil, **Conflict of Interest:** None declared.