Indian J Physiol Pharmacol 2012; 56(1): 100–104

SHORT COMMUNICATION

COMPARATIVE STUDY OF LUNG FUNCTIONS IN SWIMMERS AND RUNNERS

MEENAKSHI SABLE*, S. M. VAIDYA AND S. S. SABLE

Department of Physiology,
B.J. Medical College,
Pune – 411 001

(Received on May 4, 2010)

Abstract : In the present study pulmonary function tests of two different groups of athletes, swimmers and runners were studied and compared. Thirty swimmers who used to swim a distance of two to three kilometers per day regularly were compared with age, sex, height, and weight matched thirty middle distance runners. Runners and swimmers selected for this study were undergoing training since last three years. Tidal Volume (TV), forced Vital Capacity (FVC). Forced expiratory volume in one second (FEV_1) and maximum voluntary ventilation (MVV) were higher in swimmers than runners. 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.

Key words : athletes runners swimmers

INTRODUCTION

Beneficial effect is seen on various systems of the body due to any type of exercise if performed regularly. These systems are benefited by such exercises by way of improving their functions. Swimming and running are considered to be the best exercises for maintaining physical fitness and proper health. These above mentioned exercises have a profound effect on the lung function of an individual. The purpose of selecting swimmers and runners was swimming produces maximum effect on the lungs as compared to running.

The respiratory response to swimming exercise may be expected to be different from the response to running exercise for the following reasons –

1. Act of swimming is performed in horizontal position.

2. Ventilation is restricted in/under

*Corresponding Author : Dr. Meenakshi Sable (Pawar), Department. of Physiology, B.J. Medical College of Sasoon Hospital Campus, Pune – 411 001

water and external pressure is increased.

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

4. Diaphragm is exposed to greater pressure during swimming than running.

Above mentioned factors in the act of swimming are anticipated to produce gas exchange and circulatory responses that differ from those observed in running.

The aim of this study is to establish a relationship between the quality of exercise performed and quantitative effect of these exercises on the body.

METHODS

Present study was conducted on 30 swimmers and 30 runners in the age group of 20-30 years. The runners were undergoing training under Sports Authority of India, Western Region, Aurangabad and Krida Prabodhini for middle distance running event and swimmers were selected from various swimming clubs from Aurangabad city. All the subjects were clinically examined to rule out any respiratory disorder. Informed consent was obtained from all subjects.

The study was conducted in the department of Physiology, Government Medical College, Aurangabad in Pulmonary Function Test Laboratory by "Body plethysmograph" (ELITE-Dx Model Medgraphics, USA) Pulmonary Function Test (PFT) machine. Subject were made familiar with test procedure and techniques. Tidal Volume (TV), Forced Vital Capacity (FVC), Forced Expiratory Volume 1st second (FEV_1) & maximum voluntary ventilation (MVV) were recorded with subject in sitting position of PFT machine.

Standard statistical analysis test was applied in terms of mean and standard deviation, unpaired 't' test was applied for comparison between two groups.

RESULTS

The results of this study are summarized in Table I. The tidal volume (TV), forced vital capacity (FVC), forced expiratory volume at 1st second (FEV_1) and maximum voluntary ventilation (MVV) of swimmers and runner are given.

It is evident that the swimmers have highest value of lung volumes compared to runners.

During swimming the external pressure is high therefore the respiratory muscles along with diaphragm develop greater pressure for respiration. This leads to improvement in the functional capacity of these muscles (1).

TABLE I : Comparison of pulmonary function test of swimmers and runners.

Parameter	*Swimmers*	*Runners*	*'P' value*	*Statistical significance*
T.V.	1.73±0.29	0.94±0.285	<0.0001	HS
FVC	96.13±8.94	79.63±9.5	<0.001	HS
FEV_1	98.12±8.13	85.23±12.7	<0.001	HS
MVV	122.13±21.96	120.37±29.06	<0.0001	HS

HS = Highly Significant.
NS – Not Significant.

Our study clearly shows that among runners and swimmers, swimmers have higher value of vital capacities and forced expiratory volume in 1st second (1). It was presumed that athletic training has no ventilatory stress in the form of external pressure acting on the lungs as in swimming. The ability of individual to inflate and deflate the lungs depends upon the strength of 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 constant exercise of erector spinae muscle which increases antero-posterior diameter of the lungs. The sterenocleidomastoid, trapzius and diaphragm are being constantly exercised.

DISCUSSION

Table I shows the mean and S.D. values of tidal volume (TV), Forced Vital Capacity (FVC), Forced expiratory volume at one second (FEV_1) Forced expiratory volume at one second (FEV_1) and maximum voluntary ventilation (MVV) of swimmers and runners. In the swimmers TV (1.73±0.29), FVC (96.13±8.94), FEV_1 (98.12±8.13), MVV (122.13±21.96) were higher than runners. In the runners the values are TV (0.94±0.28), FVC (79.63±9.5), FEV_1 (85.23±12.7), MVV (120.37±29.86).

The results discussed above indicate that swimmers have higher values of lung functions compared with runners. Thereby confirming that physical training has a facilitative effect on ventilatory function and athletes have superior lung function values compared to non-athletes (3, 8, 9, 10, 11).

Regular swimming practice may tend to alter the elasticity of the lungs and chest wall which leads to improvement in the lung function of swimmer (9).

Act of swimming differs from running in the following aspects :

1. Swimming is performed in horizontal position compared to vertical position in running.

2. The breath is held in every respiratory cycle for one moment or 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” (12).

During swimming the external, pressure is high therefore the respiratory muscles along with diaphragm develop greater pressure for respiration which leads to improvement in the functional capacity of these muscles (3).

Swimmers have higher value of vital capacity and for expiratory volume in 1st second than runners. It was presumed that athletic training has no ventilatory stress in the form of external pressure acting on the lungs as in swimming (1).

The restricted ventilation experienced during swimming leads the swimmers to face intermittment hypoxia. This may result in alveolar hyperplasia and thus increased tidal volume, forced vital capacity and forced expiratory volume in 1st second than runners (14). Maximum voluntary ventilation (MVV) which depend both on the patency of airways and strength of respiratory musculature was high in runners and swimmers. This finding supports the view expressed by Leith et al (6, 1).

Endurance training increases the lung capacity, sustained ventilation and thus MVV. The higher values of MVV, in all groups of athletes in comparison to predicted normal values for Indians (11, 8) is in accordance to findings of Shapiro et al (19) who observed that athletes have larger mean vital capacity and MVV.

So the respiratory muscles and diaphragm of swimmers are required to develop greater pressure as a consequence of immersion in water during the respiratory cycle, thus leading to functionally better lung functions in swimmers compared to runners (1).

Vital capacity for swimmers, foot ball players and wrestlers and forced expiratory volume in 1st second for all the groups studied were the predicted normal in Indian soldiers by Verma et al (10) and civil population by Jain and Ramiah (13) MVV seems to be significantly higher in comparison to its predicted normal value in Indians of similar age and height (10, 13).

Astrand et al found that girl swimmers had higher values for vital capacity and total lung capacity (TLC) in relation to height than a non-atheletic reference group (14). Also the mean values for VC & FEV1 were found higher in swimmers of both sexes by Newmann et al (9). Andrew et al suggested that three years of competitive swim training produce greater lungs capacities than that might otherwise be anticipated (15).

Cordain reported that the static lung volumes were higher than normal in swimmers than runners. This was attributed to strengthening of the inspiratory muscles as they were against additional resistance caused by weight of water that compresses the thoracic cage (18).

To explain the difference in the lung volumes and capacities in swimmers and runners more extensive and detailed research with each group is required.

This study suggest that regular exercise training has an important role to play in determining and improving lung volumes, and also that swimming exercise builds up more endurance of respiratory muscles than running exercise. There is a need of further to test the hypothens.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. Swarupa Mahore, Chief Resident, Department of Preventive and Social Medicine, Government Medical College, Aurangabad for analyzing the data.

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