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Comparative Evaluation of Pulmonary Functions in Elderly Males Engaged In Land-Based and Aquatic Activities

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Abstract :-
Background *: The importance of physical activity or any form of exercise for health is well recognised, but little is known about the influence of those physical activities on pulmonary functions. Regular exercise brings about many changes in the body thereby enabling lungs to function more positively. Prolonged training results in the overall increase in muscular mass, metabolic power and strength which also includes respiratory muscles. This enhancement of the respiratory muscle mass and strength can in turn result in increased efficiency of lungs, which will be reflected in the increased lung function values.*
Aims & Objective : *Present study was conducted to explore the basic pulmonary functions in elderly males, which may generally vary according to the bio-physical characteristics including age, height, body weight, environment and mainly the lifestyle (Physically active or sedentary). Hence, the objective of the present study was to assess the differences in pulmonary functions between elderly males engaged in land-based activity i.e walking and aquatic activity i.e swimming and to compare them with sedentary individuals who were not engaged in any type of physical activity, of the same age-group.*
Material & Methods : *Pulmonary function test (PFT) was performed on 80 normal, healthy male adults between the age-group of 40-70 years, in which forty (40) were individuals daily going for a walk and forty (40) were swimmers,(both performing their respective activities for 40-60 minutes/ day, on an average five (5) days a week). These were compared with forty (40) controls of same sex and age-group with sedentary life style. Any respiratory disorder was ruled out by carefully examining all the subjects clinically before the start of the study.*
Data Analysis: *Unpaired 't' test was applied for comparing the parameters between the two groups.*
Results: *It was found that all the pulmonary function test parameters were significantly improved in swimmers (p value< 0.0001). Walkers also showed a significant improvement in pulmonary function parameters when compared with sedentary individuals (p value< 0.0001).*
Conclusion: *Both the physically active groups (elderly males involved in walking and swimming exercise) showed highly significant difference in pulmonary function test parameters when compared with sedentary individuals. Swimmers had highest pulmonary function test parameters than walkers. This may be due to the fact that vital capacity, elasticity and air flow of lungs improves because of swimming, over a period of time.*
Key Words: *Pulmonary Function Test (PFT), Land Activity, walking, Aquatic activity , Swimming, Sedentary elderly males.*

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I. Introduction

A sedentary lifestyle is defined by excessive amount of daily sitting.(1) According to Marc Hamilton a man who sits 60 hours at a desk job but works out for 45 minutes a day 5 times a week still has a sedentary lifestyle.(2)Sedentary lifestyle with physical inactivity is now a global non-communicable disease and has a greater risk of lifestyle related chronic diseases as predicted.(3,4) It is well established that a sedentary life style is associated with an acceleration of age - related physiological deterioration(5,6) such that the effects of aging and habitual inactivity may be additive.

As defined by World Health Organization (WHO), health is a state of complete physical, mental and social well being and not merely an absence of infirmity or disease. (7) And so, public's interest about the role of exercise in shaping one's life style is increasing day-by-day.(8) Regular exercise performed religiously has a beneficial effect on different systems of our body. (9) It ultimately improves the characteristics of different systems and organs of human body. (10) It is clear that respiratory and circulatory systems are in close interaction when they are taken into consideration in terms of exercise effects. During exercise, the oxygen need of the muscles is above the standard need. Thus, the respiratory system must adapt to said condition in order to

satisfy the required oxygen. However, it is known that the increased level is limited and the limits of the enlargement capacity of breathing muscles and chest wall, and elasticity levels of bronchi, lead to changes in this said condition. The amount of oxygen that the individuals use is directly proportional to the amount of energy they generate. During exercise, oxygen and carbon dioxide values tend to be maintained at an appropriate level without increasing the load on the breathing muscles. In order to satisfy the increasing oxygen need, cardiac pulse is increased, the energy consumption of the breathing muscles is decreased, and the signals that will increase the pulmonary functions tend to be minimized. As a result of said effects, the exhaustion that will occur in the breathing muscles is decreased; however, exercise performance is increased. The pulmonary capacity of the individual is related to the body structure of the individual as well as the oxygen need of the physical activity or sports performed.(11)

Regular and systematic exercise produces a positive effect on the lung by increasing pulmonary capacity, and thereby improving the lung functioning. 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 (10).

Now-a-days, more persons are interested in physical fitness than any time before. Previous health studies concluded that pulmonary function is a long-term predictor for overall survival rates in both genders and could be used as a tool in general health assessment. Hence it becomes essential to achieve more efficient lung function as a preventive measure. Sedentary lifestyles could be associated with less efficient pulmonary function. Involvement in certain physical activities or sports could help in respiratory muscle strengthening and improvement in pulmonary function.(12)

It was also observed that some particular sport disciplines improve the lung function better than others (10).

Exercises in different forms, if performed regularly, have a beneficial effect on the various systems of the body. The modality of exercise that is most beneficial and economic for masses has now become the topic of research. The conventional exercises (endurance exercises like walking, jogging, running, swimming, cycling, etc), which give stress on cardiovascular and respiratory systems and test the responses of these systems, are very popular.(13)

Lung function parameters tend to have a positive relationship with both field and aquatic activities. Hence, a lung function test (spirometry) is the best predictor for both qualitative and quantitative evaluation of pulmonary functions. Spirometry is generally used to understand the different functional aspects of the pulmonary function. Thus, spirometry is often considered as the best procedure for health monitoring, especially for the elderly physically active individuals who believed to have more sound physiological condition than sedentary people. [10].

A simpler form of training requiring no equipment is a land-based activity i.e walking. An aquatic activity i.e swimming is a difficult process for every individual particularly for elders. But both of these activities if performed regularly, produces consistent physiologic changes that have sound scientific basis. These physical activities have been found to be beneficial for better maintenance of bodily functions, even in normal, healthy elderly subjects.(12)

In the early studies it has been reported that the training regime is very important for health.(10)There are several studies that have shown significant improvements in PFTs as a result of the effect of different types of exercises. (14-17) But there are very few studies showing relationship of type of exercise and PFT in elderly individuals.

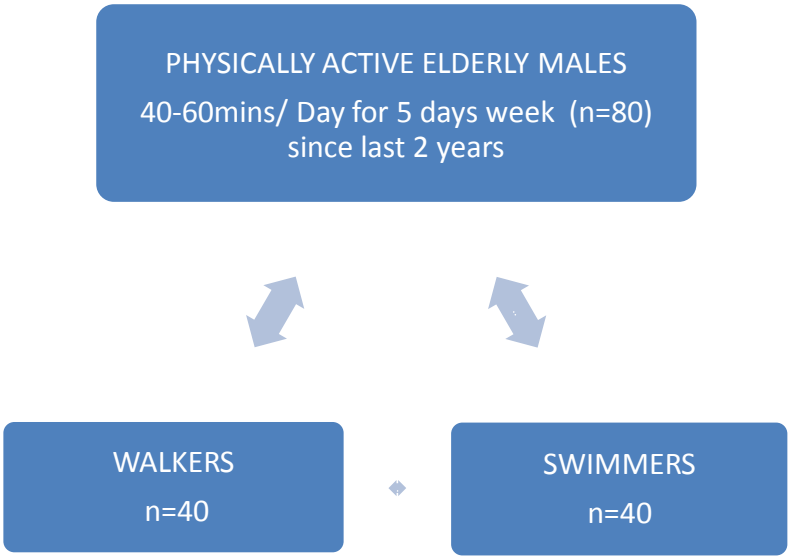
It is a known fact that the efficiency of the respiratory system and ventilation declines as age advances due to various factors. Hence, aim of this study is to compare the pulmonary functions of elderly males engaged in land activity (walking) and aquatic activity (swimming) with elderly sedentary individuals. And the objective of this study is to evaluate if walkers or swimmers have increased pulmonary functions, when compared with sedentary individuals, and if so how they differ amongst themselves in terms of spirometric parameters.

II. Materials And Method :

Present study was conducted in the Pulmonary Function Test (PFT) Laboratory, Department of Physiology, Govt. Medical College, Aurangabad.

Study Design : Case Control Study.

Cases : Eighty (80) elderly healthy physically active males, aged 40 - 70 years, were recruited as study cases. They were further divided as shown in the figure below.



Controls : Forty (40) Sedentary males were recruited as controls and care was taken that age, height, weight of the control was comparable and similar to the study cases. Matching with socio-economic status was done and none of the subject was engaged in any kind of regular physical exercise or athletic activity.

After explaining the purpose and design of the study, informed consent was obtained from all participants.

All the study participants were clinically examined to rule out history of smoking, acute / chronic respiratory disorders, cardiovascular, hepatic or renal impairment and subjects with these aliments were excluded from the study.

Pulmonary functions were recorded on Whole Body Plethysmograph - Elite - Dx model (Med-Graphics USA make) PFT machine.

Spirometric parameters analyzed were

All the parameters were recorded on subjects sitting comfortably in up-right position and at Body Temperature and Pressure Saturated (BTPS).

The test procedure was done between 3 to 5 pm for all the participants to avoid diurnal variations.

Percent (%) predicted values with respect to their characterizations as per the Breeze Suite Software for PFT were taken into consideration for statistical analysis to eliminate the effect of age, sex, height and weight on different parameters of pulmonary function.

Unpaired 't' test was applied for comparison between two groups.

III. Results

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

Table I : Demographic Variable

Parameter	**Cases (Mean + SD) WALKERS**	**Cases (Mean + SD) SWIMMERS**	**Controls(Mean+SD) SEDENTARY**
Age (Years)	62.88 + 8.24	58.03 + 5.11	60.66 + 7.84
Height (Centimeter)	165.1 + 6.8	171.1 + 2.8	164.6 + 7.1
Weight (Kilogram)	64.7 + 7.7	61 + 8.2	62.5 + 9.2

Table II : Comparison of Percent (%) Predicted values of Pulmonary functions in Elderly Walkers And Sedentary individuals

Lung Parameters	Test Group (Walkers) **(Mean + SD)**	Control Group (Sedentary) **(Mean + SD)**	'p' Value
FVC (%)	74.12+ 6.44	56.2 + 6.24	< 0.0001**
MVV (%)	85.02+ 5.94	67.5 + 6.96	< 0.0001**
FEV1(%)	76.6+ 6.2	60.27 + 6.5	< 0.0001**
FEF 25-75(%)	81.62+ 6.33	65.27 + 6.49	< 0.0001**

**** Highly Significant**

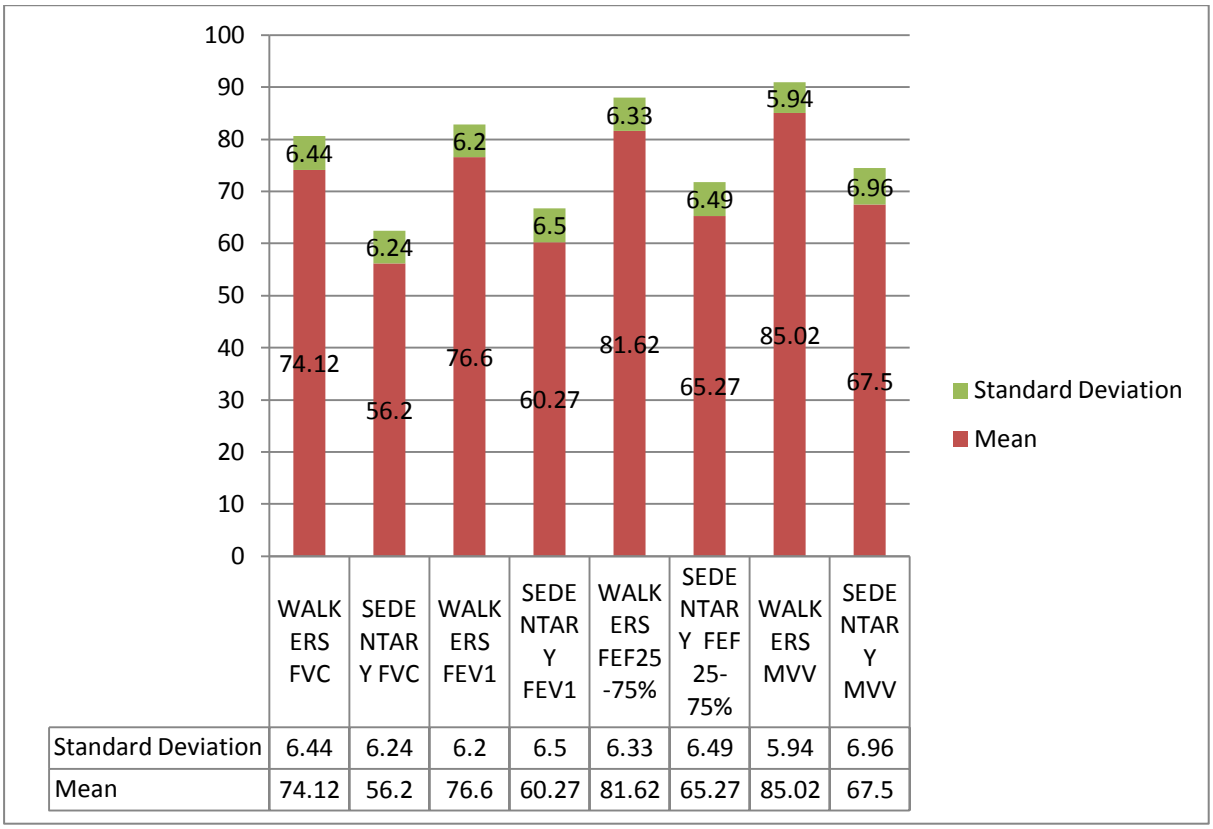
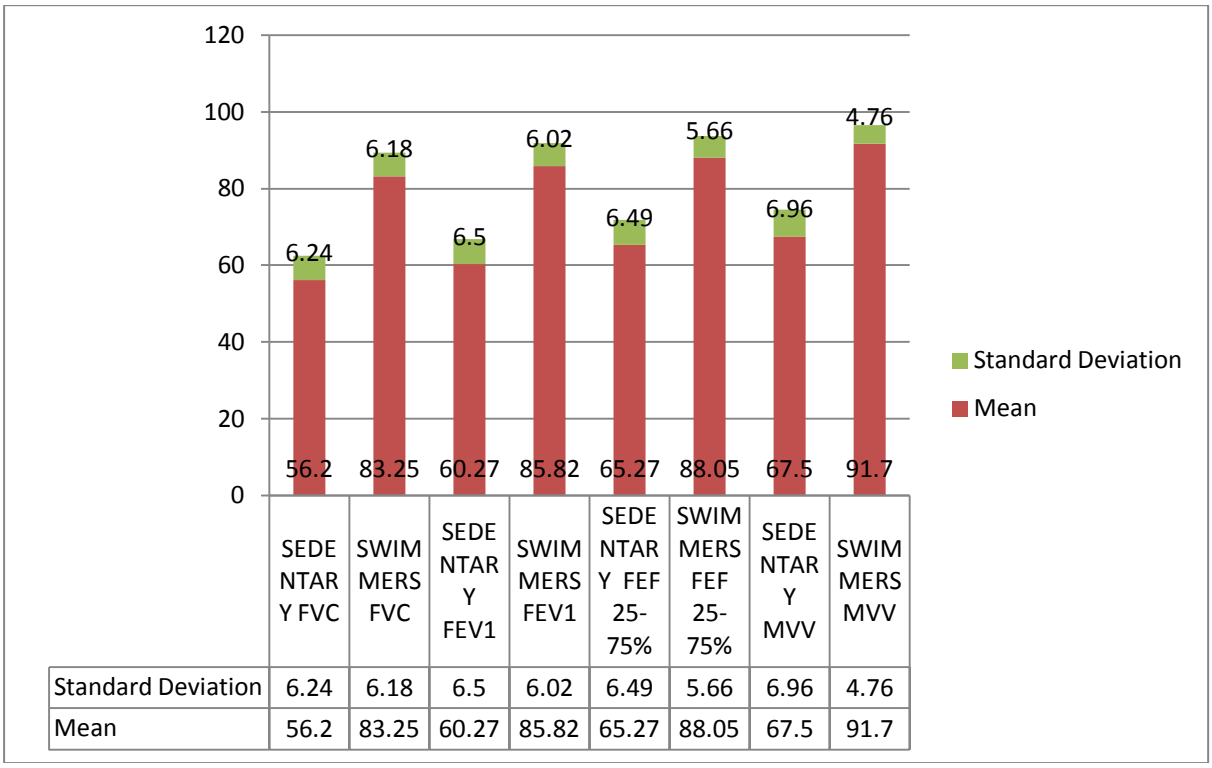


Table III : Comparison of Percent (%) Predicted values of Pulmonary functions In Elderly Swimmers And Sedentary individuals

Lung Parameters	Test Group (Swimmers) **(Mean + SD)**	Control Group (Sedentary) **(Mean + SD)**	'p' Value
FVC (%)	83.25 + 6.18	56.2 + 6.24	< 0.0001**
MVV (%)	91.7 + 4.76	67.5 + 6.96	< 0.0001**
FEV1(%)	85.82 + 6.02	60.27 + 6.5	< 0.0001**
FEF 25-75(%)	88.05 + 5.66	65.27 + 6.49	< 0.0001**

**** Highly Significant**



	SEDENTARY FVC	SWIMMERS FVC	SEDENTARY FEV1	SWIMMERS FEV1	SEDENTARY FEF 25-75%	SWIMMERS FEF 25-75%	SEDENTARY MVV	SWIMMERS MVV
Standard Deviation	6.24	6.18	6.5	6.02	6.49	5.66	6.96	4.76
Mean	56.2	83.25	60.27	85.82	65.27	88.05	67.5	91.7

IV. Discussion

Age is an un-modifiable risk factor for decreased pulmonary function. During childhood and adolescent there is a natural rise in lung function, after which it declines gradually. Regular physical activity or exercise habit may be a preventive strategy for healthy functioning of the lungs. Previous investigations on lung function variables reported that all the sportspersons or exercisers had a higher value of lung functions compared to the sedentary individuals. (18)

Physical inactivity and low cardio-respiratory fitness are recognized as important causes of morbidity and mortality. It is generally accepted that people with higher levels of physical activity tend to have higher levels of fitness and that physical activity can improve cardio-respiratory fitness. Bufferalo health study revealed FEV1 as an independent predictor of overall long term survival rates and could be used as a tool in general health assessment. Pursuing a physical activity or sport which could help in achieving efficient lung function especially FEV1 is an essential preventive strategy in this busy age when prevalence of sedentary life style is increasing and so are the associated lifestyle disorders.

The results of the present study showed that those involved in land based (walking) and aquatic

(Swimming) activity regularly had higher lung function parameters as compared to those with sedentary life styles.

A simpler form of training is land-based walking. Although guidelines recommend that walking training can be incorporated within pulmonary rehabilitation programmes, there is limited scientific evidence to support the use of land-based walking training as the sole endurance training mode. Establishing the effectiveness of land-based walking as the sole exercise modality to improve exercise capacity, would increase the accessibility of exercise training for people with COPD, especially in rural and remote locations where access to exercise equipment is limited. There has been a growing interest in the effectiveness of land-based walking programmes to improve exercise capacity, given that land-based walking training is simple to perform, readily available and easy to administer as it requires no exercise equipment. (19)

Significantly higher values were observed for FVC, FEV1, FEF25-75% and MVV in the aquatic activity performing group . Significantly higher MVV in swimmers is advantageous for physical work capacity. The results discussed above clearly indicate that swimmers had higher values of lung functions compared to the controls, thereby confirming that regular exercise has a facilitating effect on the lungs. Similar results have been obtained by other workers in this field. Pyorala et al pointed out that endurance Swimmers maintain lower and deeper rhythms of breathing, both at rest and at exercise than compared normals (12).

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 centre 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.

Swimming is a low-intensity exercise of long duration which produces increase in the number of mitochondria in the skeletal muscle fibres 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. 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. (17) 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. Lung functions and capacities are determined by the respiratory muscle strength, elastic recoil, airway resistance, and compliance of lung and thoracic cavity.(12)

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. 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.(17) 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.(20) Similar results were found in swimmers of different cities such as Lucknow and Amritsar. They have explained it on the basis of improvement in strength of respiratory muscle, thoracic mobility, and better balance between lung and chest elasticity gained from training in swimmers. 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. 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.(21) 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. Warm-up exercise before swimming for 25–45 min also improves the pulmonary functions for swimmers.(9)

As per the study, dynamic exercise can improve lung function and delay the age related changes in respiratory system.

V. Conclusion

Elderly individuals both, engaged in land and aquatic activity had significantly better lung functions as compared to sedentary individuals. Elderly individuals with sedentary lifestyles had lowest pulmonary function parameters. Sedentary life style is also associated with higher incidence of obesity, and development of restrictive lung function and cardiovascular morbidity. In this busy age people should try to be involved in such physical activities or sports with better health yield for the time spent.

From the present study it can be concluded that regular physical activity either land based or aquatic, may be a strategy to delay the age related decline of physiological pulmonary functions even in elderly age group and thus promotes healthy aging.

VI. Recommendations

Apart from the preventive value of land based physical activity i.e walking and aquatic activity i.e swimming, there is emerging realization of its benefit as a complementary therapy in therapeutic and rehabilitative medicine.

Walking exercise is a free-of-cost, non-pharmacological, complementary alternative method recommended for efficient functioning of lungs throughout the life.

So, it is recommended that elderly sedentary individuals should adopt either of the sports activity as per their convenience, for improving their health.

Limitations

1) The absolute effect of physical activity was difficult, so only leisure time physical activity was considered.
2) No other land based activities (like running, jogging or any other outdoor sport activity) and aquatic activities (like water polo, underwater sea walking and other underwater games) were considered.
3) Female elderly individuals were not studied.

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