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Original Research Article

Effect of Aerobic Training on Maximum Voluntary Ventilation in Physically Inactive Young Adults

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ABSTRACT

Background: This study investigated the relationship between aerobic activity and pulmonary function in healthy young people. Sedentism and lack of physical fitness are two major risk factors for cardiovascular disease and other causes of morbidity and mortality. Exploration of the link between aerobic exercise and pulmonary function will help to understand how aerobic exercise improves patients' quality of life and establish a more reliable means of measuring rehabilitation results.
Methods: This research has a sample size of 40 people. The participants' approval will be obtained, and those wanting to engage in the study will be chosen. A maximal voluntary ventilation (MVV) pre-analysis will be done prior to intervention. The FITT approach will be used for 4 weeks of aerobic muscle training. After four weeks of aerobic activity, the maximum voluntary ventilation (MVV) will be tested again. The data from before and after the MVV will then be analysed.
Result: The pre intervention mean of maximum voluntary ventilation was 108.37±7.97 in litre and 71.2±3.48 in litre, with a mean difference of 24.00% predicted. The post intervention mean was 132.42±13.48, with a P value of $p<0.0001$ and a t value of 13.97, indicating a significant improvement after 4 weeks of intervention.
Conclusion: The Present Study Concluded That 4 Weeks of Aerobic Training Improves Endurance of Respiratory Muscles, Respiratory Muscle Performance and Maximum Voluntary Ventilation in Young Adults.

Keywords: Aerobic Training, Maximum voluntary ventilation,

INTRODUCTION

Aerobic exercise is defined by the American College of Sports Medicine [ACSM] as any activity that engages large muscle groups, can be sustained continuously, and is rhythmic in character. The muscles engaged by this type of exercise, as the name indicates, rely on aerobic metabolism to extract energy in the form of adenosine triphosphate [ATP] from amino acids, carbohydrates, and fatty acids. Cycling, walking, running, dancing, hiking, jogging, and swimming are all examples of aerobic exercise. These activities are best accessed through aerobic capacity, which is described by the ACSM as the cardiorespiratory system's ability to deliver oxygen and the skeletal muscles' ability to consume oxygen. (1)

More than 25 lakh fatalities worldwide are related to cardiovascular (CV) illness caused by a lack of physical exercise. Physical inactivity, on the other hand, is thought to be responsible for 30% of ischemic heart disease. The link between physical inactivity and CV disease has gained traction in the medical community.

The World Health Organization's (WHO) 2010 guidelines included activity recommendations based on three age groups:

5-17, 18-64, and > 64 years of age. Individuals between the ages of 5 to 17 should engage in at least 60 minutes of moderate exercise every day. Those aged 18 to 64 should engage in at least 150 minutes of moderate activity or 75 minutes of strenuous activity each week.

Aerobic training is based on proper frequency, intensity, and duration of exercise. Training causes cardiovascular and/or muscle adaptation, which itself is reflected in a person's endurance. Training for a certain sport or event is based on the specificity principle, which states that an individual may improve in the exercise activity chosen for training but may not improve in other tasks. Swimming, for example, may boost performance in swimming events but may not improve performance in treadmill running. [(4)] The capacity of your body to deliver oxygen to your muscles during extended activity is the first component of cardiorespiratory fitness. The ability of the muscle to absorb and utilize oxygen while exercising is the second component of cardiorespiratory fitness. [(4)]

The maximum voluntary ventilation (MVV) is a spirometric measure that has received little attention in the scientific literature. It has recently received even less attention as new ways of assessing lung function have emerged. The greatest volume of air a person may inhale and exhale willingly in one minute is indicated by MVV. This metric gives data on respiratory muscle mechanics and endurance, both of which are important in the mechanism of dyspnoea and exercise restriction. The hypothesis investigated in this study is that MVV can predict overall impairment of people with COPD better than FEV1 because it represents the total function of the respiratory system rather than simply the air-flow restriction. In this context, the goal of this study was to look at the link between MVV and clinical outcomes in this population, as well as to see if MVV is a stronger predictor of patient-reported outcomes than FEV1. [(12)]

MVV is the measures of respiratory muscle performance. For the comfort of the patient this is done over a 15 second time period before being extrapolated to a value for one minute expressed liters /minute. Average values for male and female are 140 - 180 and 80-120 liters per minute respectively. [(2)]

Impaired pulmonary functions are linked to an increased risk of mortality and morbidity. [(7)] Physical fitness and the reduction of morbidity and mortality from a variety of chronic diseases. There has been very few research on aerobic exercise and pulmonary function in the general population. The majority of research on the effects of physical exercise are cross-sectional, focusing on specific populations such as athletes or COPD patients. Physical activity therapy is commonly employed in pulmonary disease patients. (2)

Exploration of the relationship between aerobic exercise and respiratory function will benefit in understanding how aerobics improves patients' quality of life and in developing a more accurate method of evaluating the effects of rehabilitation. The purpose of this study was to look at the link between aerobics exercise and MVV in healthy young adults. [(2)]

With the advancement of technology, individuals have adopted a sedentary lifestyle. Technological advancements have reduced the time of physical exercise in people's everyday lives. Sedentism and inactivity produce a slew of health issues. As a result, it is critical to develop the habit of exercising and participating in sports at a young age. Physical activity and exercise are required to prevent the negative consequences of sedentary living and to keep the organism healthy and fit.[(5)]

Sedentism and a lack of physical fitness are the most common modifiable risk factors and predictors of both cardiovascular disease and all other causes of morbidity and death. High levels of cardiopulmonary fitness have been studied and confirmed to give significant and independent predictive information regarding the overall risk of disease and death due to cardiovascular causes.

Physical activity and exercise are beneficial to one's overall health and quality of life.

Adults should exercise moderately for at least 30 minutes a few days a week to minimise the detrimental consequences of sedentary lifestyle. [6]

Physical activity and exercise will boost the respiratory muscle's strength and volume. Endurance exercise aids in the cellular adaptations of respiratory muscles and the respiratory system. Traditionally, the functioning condition of the respiratory system may be assessed by measuring lung volumes and capacities. Physical exercise causes changes in respiratory volume and frequency. Aerobic activities assist athletes increase their oxygen system. The maximum amount of oxygen available to the muscles during voluntary physical activity is defined as aerobic capacity [VO2 max]. VO2 max is now the best component for determining cardiorespiratory fitness; it is directly related to cardiovascular health, and its improvement has been associated to a reduction in the risk of mortality from cardiovascular disease.

Aerobic workouts are likely to be seen as one of the pillars of a good and healthy existence. Exercise programmes are implemented with the goal of achieving a quality and healthy life.

This research is significant for understanding the link between aerobic exercise protocols, respiratory functions This research is significant for understanding the link between aerobic exercise protocols, respiratory functions and the development of sedentary exercise routines. [3]

Physical health is the foundation of all activities in our society. Cardiorespiratory fitness, on the other hand, indicates the total capacity of the cardiovascular and respiratory systems, as well as their ability to do activity for an extended amount of time. As a result, cardiorespiratory fitness is regarded as a straightforward and accurate indicator of an individual's physiologic state.

MATERIALS & METHODS

The study received ethical clearance by the Institutional Ethical Committee of Dr. A.P.J Abdul Kalam College of Physiotherapy, PIMS-DU. The study setting and the source of data collection was Dr. A.P.J Abdul Kalam College of Physiotherapy, PIMS-DU. The study design was pre and post Comparative study. This study consisted of 40 participants according to the inclusion and exclusion criteria. The inclusion criteria were 1) Those who are willing to participate. 2) Physically inactive Students. 3) Both male and female of age group 18 to 25 years are included. while the exclusion criteria 1) Known case of Asthma, Congenital heart diseases. 2) Case of psychological disease/disorder 3) Any history of lower limb fractures or surgeries. 4) Obesity (BMI above 25). [8]

Based on the inclusion and exclusion criteria given above, the participants were chosen using a basic random sampling approach. The permission of the participants will be gained, and those who wish to participate in the project will be picked. All information, the study's methodology, and how the participants would benefit will be explained. A maximum voluntary ventilation (MVV) pre-analysis will be performed prior to intervention. The FITT approach will be used for 4 weeks of aerobic muscle training. After four weeks of aerobic activity, the maximum voluntary ventilation (MVV) will be tested again. The data from before and after the MVV will then be evaluated.

STATISTICAL ANALYSIS AND RESULT

In this study, young adults were given aerobic training for four weeks. Participants were chosen based on inclusion and exclusion criteria, and then pre maximum voluntary ventilation was taken, followed by four weeks of aerobic training. After the training, participants were assessed again with post maximum voluntary ventilation.

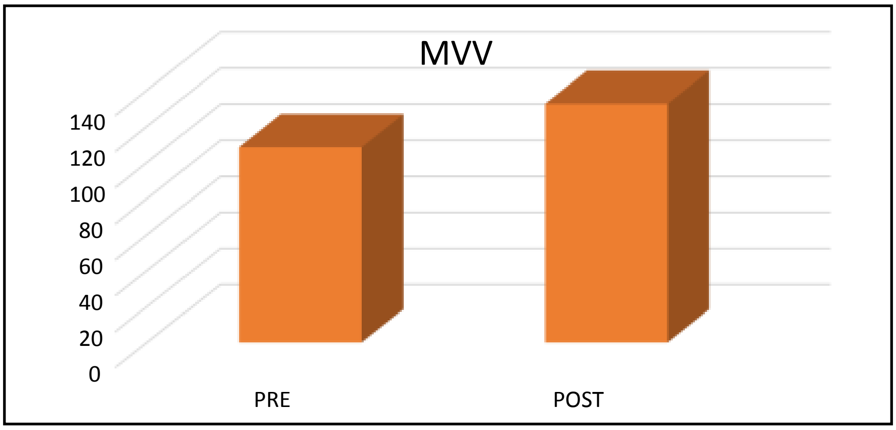
The mean in the age group was 21±1, mean within the weight was 69.52±13.80 in kgs, mean within height was 174.85±6.57 in cm.

Pre-Intervention Mean of maximum voluntary ventilation was 108.37±7.97 in liter & 71.2±3.04 % predicted and post Intervention Mean was 132.42±13.48 in liter

& 87.02±7.00 % predicted with mean difference of 24.05 with P value of p<0.0001 and t value of 13.97 which shows significant improvement in Maximum voluntary ventilation after 4 weeks of intervention.

Table no.1. Comparison of Pre intervention and Post intervention on Maximum Voluntary Ventilation.

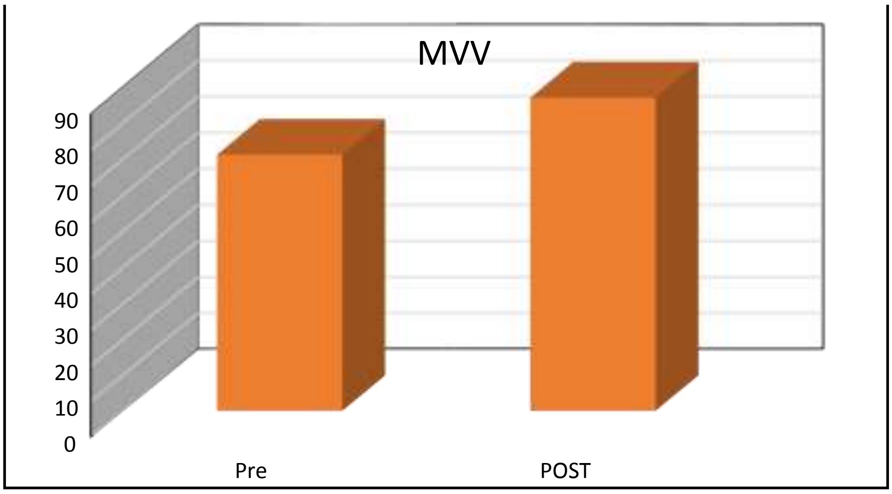
MVV	PRE	POST	MEAN DIFFERENCE	t value	P value
	MEAN±SD	MEAN±SD			
In litres	108.37±7.97	132.42±13.48	24.05	13.97	P<0.0001 Extremely Significant



Graph No.1. Comparison of Pre intervention and Post intervention on Maximum Voluntary Ventilation.

Table no.2. Comparison of Pre intervention and Post intervention Maximum Voluntary Ventilation in Percent Predicted.

MVV	PRE	POST	MEAN DIFFERENCE	t value	P value
	MEAN±SD	MEAN±SD			
In litres	71.2±3.04	87.02±7.00	15.82	148.13	P<0.0001 Extremely Significant



Graph No.2. Comparison of Pre intervention and Post intervention Maximum Voluntary Ventilation in Percent Predicted.

DISCUSSION

The current research was carried out to investigate the influence of aerobic exercise on maximal voluntary ventilation in young people. The young people were subjected to a four-week research. The aerobic training consisted of treadmill walking, static bicycle, and running for 30 minutes with a 10-minute cool down to determine the effect on maximal voluntary ventilation.

Our study showed Pre-Intervention Mean of maximum voluntary ventilation was 108.37±7.97 in liter & 71.2±3.04 % predicted and post Intervention Mean was

132.42±13.48 in liter & 87.02±7.00 % predicted with mean difference of 24.05 with P value of $p<0.0001$ and t value of 13.97 which shows significant improvement in Maximum voluntary ventilation after 4 weeks of intervention.

Potential mechanism the reason for this is that aerobic activity improves blood flow to the respiratory muscle by increasing ventilation demands, which in turn increases the neural drive to the respiratory muscle and increases maximal inspiration pressure. Therefore, it indirectly enhances the respiratory muscle's strength, maximum exercise capacity, functionality, and endurance of respiratory muscles (maximum Voluntary ventilation)

Physical inactivity and a lack of cardiorespiratory fitness are known to be major causes of illness and death. It is widely known that those who engage in more physical activity tend to be more fit, and that physical exercise can increase cardiorespiratory fitness. MVV rose considerably after 4 weeks of treadmill walking, static bicycle, and jogging in the current study. Thus, our findings corroborated the finding that there is a beneficial association between aerobics exercise and respiratory muscle function.

MVV is the measure of respiratory muscle performance. Positive relation of MVV improvement showed that the respiratory muscle performance enhancement due to aerobic exercise can improve lung function. This is consistent with a previous study by Chaitra Bidare et al,(2013) Conducted a study on how Aerobic Training Affects Maximum Voluntary Ventilation. They recruited forty apparently healthy male medical students aged 17-20 years. Randomization into experimental and control groups (20 each), was carried out with a table of random numbers. The experimental group participated in a 16 weeks aerobic exercise plan. MVV was recorded before the commencement of training and at the end of training. Results showed that there was significant improvement in MVV in the intervention group at the end of training improving respiratory muscle function.

Another similar study was done by Arwa Rawashdesh et al,(2018) conducted a study on Effect of High-Intensity Aerobic Exercise on The Pulmonary Function Among Inactive Male Individuals. The study was conducted for three weeks. The test was performed three times and its mean value was used for analysis. MVV significantly improved after high-intensity aerobic exercise. The results demonstrated that high intensity aerobic exercise on the treadmill has a positive effect on the pulmonary function of inactive healthy subjects.

Farid R et al. showed an improvement in pulmonary function with aerobic exercise training in asthma patients. Nourrey C et al. showed in a prospective study that aerobic exercise improves pulmonary function and alters exercise breathing pattern in children. Clark CJ found that cardiorespiratory fitness significantly improved and breathlessness decreased over a wide range of physical work corresponding to activities of daily living. Kaufman C et al. studied the effect of aerobic training on ventilatory efficiency in overweight children, and found that the training helped to reverse the decrements in cardiopulmonary function observed over a period of time in overweight children.

Our study also showed that the subjects were able to have more powerful and more effective inspiration and expiration as opposed to what they have been able to before participating in such aerobics training.

One limitation of our study is that most of our healthy subjects were from mid to upper socioeconomic strata and only male students were included in the study. This shortcoming may affect the generalization of the results to other sections of society.

Due the sedentary life style respiratory muscle endurance is significantly reduced in adults. The respiratory muscle endurance is an important factor of maximum voluntary ventilation; therefore, it is important to maintain it for which aerobic training should be given was proved in our study.

CONCLUSION

The Present Study Concluded That 4 Weeks of Aerobic Training Improves Endurance of Respiratory Muscles, Respiratory Muscle Performance and Maximum Voluntary Ventilation in Young Adults.

Declaration by Authors

Ethical Approval: Approved

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Conflict of Interest: The authors declare no conflict of interest.

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