Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(7A):2348-2352 **ISSN 2347-954X (Print)**
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(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjams.2016.v04i07.008

Original Research Article

Study of Muscle Function in Young Adults

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Abstract: Muscles are the only tissue in the body that has the ability to contract and therefore move the other parts of the body. Physical activity is the one important factor which affects the skeletal muscle function. Regular physical activity is recommended in youth today to improve the physical and mental well being. The aim of this study is to assess the skeletal muscle function in sedentary and physically active young adults by using Mosso's ergogaph and 40mm endurance test. **A** cross sectional study was conducted among 50 sedentary and 50 physically active healthy medical and paramedical students in the department of Physiology, Sri Ramachandra Medical College & Research Institute, Chennai. Both sexes were included in this study and their age group is between 17 to 28. Our results showed that work done and respiratory endurance were higher in physically active young adults than sedentary young adults in both sexes. So we conclude that regular physical activity increases the strength of the muscles and increases the endurance of the respiratory muscles which improves the cardiorespiratory efficiency in young adults.
Keywords: muscle strength, endurance, sedentary, physical activity, young adults

INTRODUCTION

A skeletal muscle is a contractile tissue showing many functions like any other organ in the body. Through contraction and relaxation, skeletal muscles give support to the body and movement of the body parts. Muscle cells contain contractile protein filaments of actin and myosin which slides one another producing a contraction and changes both the length and the shape of the cell. Muscles function is to produce force and motion. They are primarily responsible for maintaining and changing posture, locomotion. The strength of any given muscle, in terms of force exerted on the skeleton depends upon length, shortening speed, cross sectional area, sarcomere length, myosin isoforms and neural activation of motor units. The work done is calculated to study the effect of various factors on the muscle performance. Factors like age, sex, height, physical build, training, race and motivation affect the performance of the individual [1].

The degree, duration and type of work done are the important factors that in general affect the onset of fatigue. Physical training increases the blood supply to contracting muscles delay the onset of fatigue and improves the performance. Encouragement, motivation improves performance for a short time. Encouragement stimulates the frontal lobe of the cortex that increases the activity in the motor cortex. This in turn stimulates the flexor muscles by increasing the activity in the corresponding motor neurons [1]. This shows that cerebral cortex is involved in fatigue in humans. In sports physiology, motivation plays an important role in enhancing performance [2].

Diaphragm, the chief muscle of inspiration is composed of skeletal muscle and stretches to the lower-most part of rib cage. Diaphragm, a domed sheet of muscle that separates the thoracic and abdominal cavity and performs an important function in respiration. During inhalation, the diaphragm and the external intercostal muscles contracts and moves in the inferior direction, thus enlarging the volume of the thoracic cavity. This reduces intra-thoracic pressure and air is drawn into the lungs. In physically active individuals, the endurance of the respiratory muscles increases. Regular physical activity improves the overall performance and working capacity of the individual. In today modern world physical activity is less and

sedentary lifestyle is commonly seen among young adults [3]. Hence this study was undertaken to evaluate skeletal muscle function using Mosso's ergograph and 40mm endurance test among sedentary and physically active young adults.

MATERIAL AND METHODS

This cross-sectional study was conducted in the Department of Physiology, Sri Ramachandra Medical College and Research Institute, Porur, Chennai. 50 sedentary and 50 physically active healthy students were participated in this study and aged between 17 to 28. Both sexes were included in this study. History of any cardiac and respiratory illness were excluded from the study. Approval was given by the institutional ethics committee, Sri Ramachandra University, Chennai to conduct this study. Protocol of the study and the benefits of the study was explained to the subjects and written consent was obtained before the study. Physical activity questionnaire was administered [4]. Anthropometric measurements, clinical examination and muscle function tests were done to all the study subjects.

Ergo graph is an instrument used for recording the voluntary contractions of the skeletal muscles of a human being on a Physiograph. Mosso's ergography is used to assess the performance of the flexors of the finger of the hand, this is also performed to study the phenomenon of fatigue in human skeletal muscle. In mosso's ergograph, there is an arrangement for fixing the finger and forearm in the appropriate holder. A cord passing over a pulley and carrying a load at one end is attached to a sliding plate. The sliding plate is connected through a sling to the finger, the flexors of which is being studied. When the middle finger is flexed, the load is lifted and the distance through which the load is marked by the paper in the sliding plate as a graph called ergogram. Alternately, arrange a spring loaded writing device or ballpoint pen in the Mosso's ergograph and a paper on the platform underneath.

Proper instructions about the procedure was explained to the subjects. The forearm was fixed on the ergograph by means of clamps. Allowed the middle finger in the loop to be pulled, and inserted the index and ring finger into the fixed metal tubes provided in the ergograph. Adjusted the subject position and various adjustable points in the ergograph in such a way that the forearm is properly fixed, and at the same times the subject is comfortable. With the middle finger extended, weight of 3 kg was suspended on the ergograph. The weight should be such that the subject must exert a real effort to lift it up. The metronome was set at one beat per two seconds i.e. to a frequency of 30/minute. And asked the subject to make a series of maximal contractions without moving the shoulder at regular intervals following the beat of metronome. Continue the contractions until the fatigue is so great that weight can no longer be moved and the reading was calculated.

40 mmHg endurance test was conducted by asking the subject to take in a full breath and blow against the mercury column in a sphygmomanometer to the pressure of 40 mm, maintaining it as long as possible. The time (in seconds) for which the subject could maintain the mercury level at 40mm Hg was noted. The lips were secured tightly around the mouthpiece with the help of fingers to ensure that there was no leak. Care was taken to see that the subject did not use oral muscles or tongue to develop pressure to block the tubing. Three trials were given with five minutes rest interval between the trials and the best value was taken for statistical analysis.

STATISTICAL ANALYSIS

The data was expressed in mean ± SD. Comparisons between groups for all the measured variables were made using independent 't' test**.** Data was analysed using SPSS (Statistical Package for social sciences) version 19. A 5% level of probability was used to indicate statistical significance. Statistical significance (<0.05).

Table 1: Comparison of work done (kg/m) (Mosso's ergograph) between sedentary and physically active male and female subjects

S.no	Parameter		Sedentary (Mean ±SD)	Physically Active (Mean ±SD)	P Value
1.	Work done (kg/m) (Mosso's ergograph)	Male	22.9 ± 3.6	32.3 ± 2.5	0.000
		Female	23 ± 3.3	32.4 ± 1.5	0.000

Data expressed as mean ±SD
Statistical significance (p value <0.05)

Table 1 shows comparison of work done (kg/m) between sedentary and physically active male and female subjects recorded by Mosso's ergograph. The work done was significantly higher in physically active group than sedentary group in both sexes.

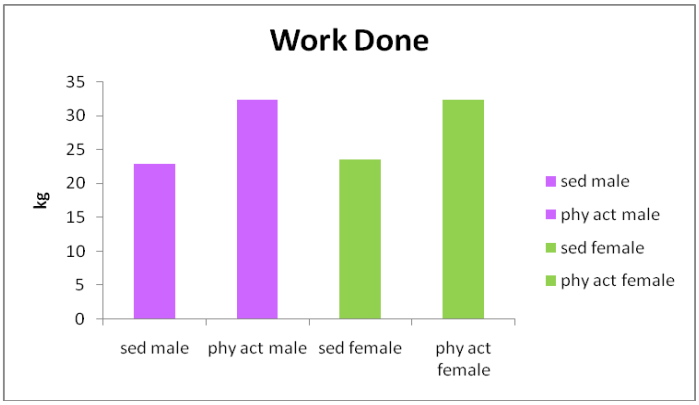

Fig-1: Comparison of work done in sedentary and physically active male and female subjects

Work done was significantly higher in both physically active males and females subjects when compared to sedentary males and females.

Table 2 shows comparison of respiratory endurance (seconds) between sedentary and physically active male and female subjects . The respiratory endurance was significantly higher in physically active group than sedentary group in both sexes.

Table 2: Comparison of respiratory endurance test (seconds) between sedentary and Physically active groups

S.no	Parameter		Sedentary (Mean ±SD)	Physically Active (Mean ±SD)	P Value
1.	Respiratory endurance (sec)	Male	24.7 ± 10.2	35 ± 9	0.000
		Female	25.8 ± 9.2	36.6 ± 8.8	0.007

Data expressed as mean ±SD
Statistical significance (p value <0.05)

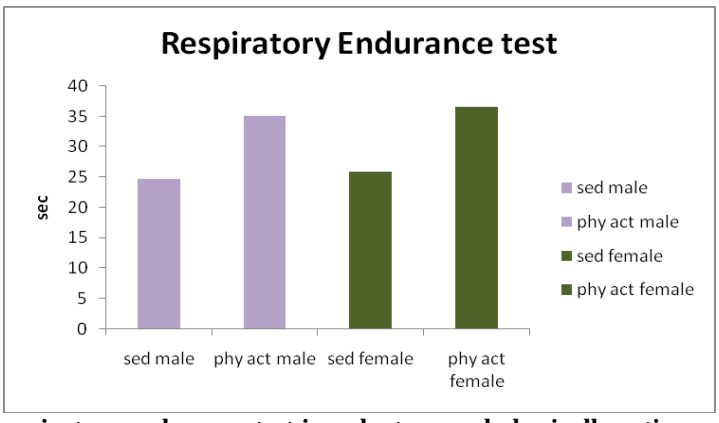

Fig-2: Comparison of respiratory endurance test in sedentary and physically active male and female subjects

Figure 2, Respiratory efficiency tests, 40 mm endurance was significantly higher in physically active males and females subjects when compared to the sedentary males and females.

DISCUSSION

Skeletal muscle is a fascinating biological tissue able to transform chemical energy to mechanical energy. The production of movement and force is the mechanical outcome of skeletal muscle contraction. Physical activity is often recommended in all age groups to improve motor skills, fitness, muscle and bone strength, and joint functions.

Work done by upper extremity using Mosso's ergograph

In this study, we have observed from the results that the work done by the flexors of the fingers using Mosso ergograph was significantly higher in physically active young adults as compared tosedentary in both sexes (Table 1). Mosso's ergograph records the isometric contractions of finger flexor muscles. Work done calculated is higher in physically active subjects and muscle function testing useful in determining the proper function, strength and endurance of muscles or muscle groups in the body [5, 6]. This could be explained on the basis of the primary factor influencing the muscle's strength is muscle size. Muscle size is the

most important single factor determining the tensile force generated by a muscle's contraction [7, 8]. The force of contraction is a function of the number of cross-links made between the actin and myosin chains [9, 10]. The more cross-links formed, the stronger the force of contraction. Therefore, the force of contraction depends upon the amount of actin and myosin available and thus on the number of fibers a muscle contains. In other words, the force of contraction is related to a muscle's size [11, 12].

Muscle hypertrophy or the increase in muscle mass through an increase in the size of its component cells due to regular exercise particularly weight training is a noticeable long-term effect of exercise. Physical activity has several effects upon muscles, connective tissue, bone, and the nerves which cause muscle hypertrophy, an increase in size. Muscles can grow larger and it is affected by many factors which includes hormone signaling, developmental factors, strength or physical training, and disease. Muscles can grow larger through a combination of muscle cell growth as new protein filaments are added along with additional mass provided by undifferentiated satellite cells alongside the existing muscle cells [13]. Regularly doing physical activity improves the endurance of the skeletal muscle function by increasing mitochondrial number and function [14-16].

Muscle function testing is used to measure muscle contractions, fatigue, endurance, strength, physical capacity under varying conditions. Fatigue is a reversible physiological state in which there is an objective reduction in the performance or its absence resulting from continuous and prolonged activity. Sedentary person goes into fatigue sooner. In sedentary adults, inadequate supply of nutrients like oxygen, creatine phosphate, ATP and depletion of neurotransmitters and accumulation of metabolites early are mainly responsible for the onset of fatigue. Thus in an intact body during continuous voluntary muscular effort, central nervous system (synapse) appears to be the primary site of fatigue as it is highly sensitive to changes in oxygen supply and to accumulation of metabolites. The next site of fatigue is neuromuscular junction and lastly the site of fatigue is in the muscle proper [1]. The factors which influence onset of fatigue are types of muscle fibers, training and blood flow [17]. Highly trained endurance athletes show larger slow twitch fibres than fast twitch fibres in the same muscle. Muscles of a trained person resist onset of fatigue and the amount of blood flowing to the muscles provide nutrients and oxygen and remove the metabolic products in trained individuals.

Benefits of ergography

Research studies have been proved that ergography was used as a therapeutic and prognostic test to evaluate functional capacity and to measure the progress of the patient during treatment aimed at restoration of function. It is useful in effective rehabilitation and to evaluate the magnitude of residual disability when there is injury that full recovery is impossible [18].

Respiratory efficiency using 40mm endurance test

Regular physical training increases the delivery of oxygen to the tissues and removal of carbon dioxide from the body. Physical training enhances the respiratory efficiency by increasing the strength of diaphragm and intercostal muscles, and by increasing the number of alveoli. It increases the vital capacity and prolongs the breath holding time. Breath holding training is useful in athletes to improve their respiratory endurance and their performance [19]. Breath holding test is used as a rough index of cardiopulmonary reserve. According to our results, respiratory endurance assessed by 40 mm Hg test was higher among physically active adults compared to sedentary adults which was statistically significant (Table 2). Regular physical training improves the efficiency of the higher centers and prolongs 40 mm Hg endurance time by decreased responsiveness of respiratory center to CO_2 and by altering the responsiveness of medullary and systemic arterial chemoreceptors. This could be also due to increased development of respiratory musculature causes increased muscle endurance and delays the onset of their fatigue.

CONCLUSION

From our study we conclude that skeletal muscle functions were higher in physically active young adults than sedentary young adults. Ample of research studies shown that physical exercise has influence on the genetic function of the muscle fibers, can modify the structure, metabolism and promotes the release of growth factors. Regular physical activity in young adults not only improves skeletal muscle function but it gains importance in the prevention of major metabolic disorders in later life [20, 21].

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