Research Paper Medical Science

Comparison of VO_2max between Trained and Untrained Young Adults

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ABSTRACT

VO_2 max is measure of maximum amount of oxygen that an individual can use. It is measured in milliliters per kg body weight per minute (ml/kg/min). As we increase our effort when we exercise, the amount of oxygen we consume to produce energy (and hence rate at which release carbon dioxide) increases. However, there is maximum level of oxygen consumption beyond which increase in exercise intensity does not lead to further increase in oxygen consumption. This level of oxygen consumption is called the VO_2 max. The purpose of present study was to compare VO_2 max between trained and untrained young individuals which was measured with the help of bicycle Ergo meter. VO_2 max in trained is significantly higher than in untrained individuals.

KEYWORDS : VO_2 max, bicycle Ergo meter, endurance exercise

Introduction

Human body functions as a multitasking machine; it performs simple work as lifting a weight to as complex and awe-inspiring as the accelerating spin of the ice skater who creates beauty out of conservation of angular momentum. A muscle can be assumed basically as an engine obtaining its energy primarily from the burning of fuel. But it varies from other man made machine, as rightly stated by Eugene(1978) " by the essential beauty of life, and its central mystery, in its ability to create order out of chaos- structure out of noise- surely the greatest of all bootstrapping operation"

When a person starts an activity then there is an increase, in his pulse rate, in the stroke volume of heart and hence in the cardiac output and blood pressure with time. Increase in the rate of respiration, with time and in the ventilation per kg body weight had good correlation with the absolute work intensity, whereas by the exercise on bicycle Ergo meter, the absolute oxygen consumption for an individual can be measured.

A physically fit person can perform a given grade of light, moderate and exhausting work more efficiently and less displacement of his physiological equilibrium further for a long period of time as compared to an unfit person. Fit person has better recuperative powers in the sense that he can return to his normal steady state after an exhausting exercise more rapidly. Thus physical fitness can be defined as a quantitative expression of the physical condition of an individual. It could also be defined as the fitness to perform a specific task requiring muscular effort in which speed and endurance are the main criteria.

Exercise training brings about adaptive increase in performance capacity. The nature of the adaptive responses varies with the type of exercise stimulus, each with its own specific pattern of responses.

One type of exercise involves the learning movement pattern and result in development of skill, with increase in coordination activity. This type exercise is exemplified by activities such as fencing, the various ball games, driving car and playing musical instrument. The primary adaptive changes takes place in the central nervous system and must involve a programming processes initiated by repeated performance of a movement pattern until it becomes a conditioned reflex.

A second type is strength exercise, which involves relatively few very forceful muscle contractions and is exemplified by weight lifting. It results in hypertrophy of muscle cell with increase in the strength. This hypertrophy appears to due to an increase in protein synthesis and decrease in the rate of protein degradation.

The third type is endurance exercise, which is exemplified by activation such as long distance running, swimming or bicycling. It results in increase in endurance capacity and in the maximum capacity to utilize oxygen made possible by adaptation in the skeletal muscle, in the cardiovascular system, respiratory system and autonomic nervous system. In contrast to strength exercise, endurance exercise does not result in muscle hypertrophy or increase in strength.

VO_2 max is measure of maximum amount of oxygen that an individual can use. It is measured in milliliters per kg body weight per minute (ml/kg/min). As we increase our effort when we exercise, the amount of oxygen we consume to produce energy (and hence rate at which release carbon dioxide) increases. However, there is maximum level of oxygen consumption beyond which increase in exercise intensity does not lead to further increase in oxygen consumption. This level of oxygen consumption is called the VO_2 max.

Objective

To compare VO_2 max between trained and untrained young individuals.

Material and Method

The present work was undertaken in department of physiology, N.S.C.B. Medical College, Jabalpur, M.P. The subjects comprised of 48 male young medical students of age group 18 to 25 years. They have been classified into two groups trained 24 and untrained 24, according to the actual events in which they were proficient.

Trained – Those students participated in endurance exercise like running, swimming and bicycling since minimum three months.

Untrained – They are healthy subjects randomly selected students.

Preparation of the subjects

All the procedures were performed in the morning. The subjects were told to come after a light breakfast. After coming to the laboratory, their heights and weights were recorded with the subject wearing minimum clothing. Each of the subjects was examined clinically for any sign of cardiovascular disease and only those found normal were allowed to undergo test. The subject was explained in detail about the investigations and apparent risk associated with it.

Measurement of VO_2 max was done by using Bicycle Ergo meter. After calibration of equipment the test was performed. Subjects were asked to sit on bicycle after proper wearing of mask and chest belt. Seat and bar height of the Bicycle Ergo meter were adjusted according to the subject's specifications, and resting gas exchange data were recorded. After that the exercise was started, with subjects completing the predetermined VO_2max protocol of between 8 and 12 minutes duration. Subjects were instructed to maintain a pedal cadence between

80 and 100 rpm during exercise and to exercise to volitional fatigue. The test uses progressive 1-minute increments in the power output and the measure of performance is the highest power output you are able to complete. The initial power output is 50 watts and the power output is increased by 15 watts each minute throughout most of the test but at smaller increments if the test continues for a longer period. The final score is the watt level attained while completing the full 1 minute increment. Termination of the test occurred when the subject was unable to maintain a pedaling cadence of 40 rpm.

Observations –

Table-1: Physical characteristic of the subjects.

Subjects	No	Age (yrs)	Height (cm)	Weight (kg)	Resting pulse rate per min
Untrained	24	20.3±1.6	162.5±2.2	52.4±1.5	85±6
Trained	24	25.5±2.6	170.8±3.5	57.6±3.8	69±8

Table-2: VO_2 max in different groups of subjects

Subjects	Max pulse rate per min	VO_2 max lit per min	VO_2 max ml per kg per min
Untrained	205±12	1.98±.10	37.20±1.90
Trained	195±20	3.14±.22	50.50±2.50

Results –

1. VO_2 max is significantly different between the trained and untrained groups (p value < .01) i.e. VO_2 max in trained is significantly higher than in untrained individuals.
2. Maximum pulse rate is not significantly different between trained and untrained groups (p value >.01)

Discussion -

- VO_2 max determination is too cumbersome for both the subject and the investigator since the person has to work up his maximum and it takes a lot of enthusiasm on the part of the subject to work to his maximum ability.
- The selection of the subjects was done in such a way that they were having extreme level of training status so that the feasibility of using an index at sub maximal load can be best determined. Though all the subject of the trained group participated in endurance exercise like running, swimming and bicycling. The untrained group included person of sedentary habits and habituated to normal physical activity.
- Maximum pulse rate is not significantly different between trained and untrained groups. Heart rate at a particular sub maximal load can be used as approximate index for the fitness but not ideal index for the fitness.
- VO_2 max, or the maximum rate at which an individual's body can consume oxygen during exercise, is the most popular measurement of aerobic capacity. Although endurance ability is mostly a matter of genetics, maximal oxygen uptake can be improved with targeted training. High intensity interval training workouts have been shown to do the trick, increasing athlete's VO_2 max. Another piece of the endurance puzzle is the athlete's lactate threshold, or the level of exertion at which lactate accumulates in the muscles. Luckily, it's possible for virtually any athlete to improve both of these measures. Endurance athletes often have a higher proportion of slow-twitch muscle fibers, which power steady-state activities like running by using oxygen efficiently to generate more energy. Running long can train slow-twitch muscles to fuel such workouts more efficiently and to fight fatigue more effectively. A continuous practice of long-distance running can also help convert fast-twitch muscles to slow-twitch muscles, which will enhance endurance.

Conclusion-

VO_2 max is significantly higher in trained individual than the untrained (p<.01). Endurance exercise training results in an increase in VO_2 max. The magnitude of their increase depends on the individual's initial level of training and on the intensity, frequency and duration of exercise. Generally, the increase in VO_2 max results from an increase in arteriole-venous O_2 difference. This increase in arteriole-venous O_2 difference results from an increase rate of extraction O_2 by the working muscles which can be explained only by the higher level of oxidative enzymes in muscles of the trained individuals.

References –

1. Lippincott Williams & Wilkins (2010), **"**ACSM's Guidelines for Exercise Testing and Prescription",8th edition.
2. Astrand and Rodhall (1970), Text book of work physiology, Mc Graw Hill, New York.
3. Astrand, P.C. (1956), "Human physical fitness with special references to sex and age", Physiol. Rev., 36,: 307- 335.
4. Astrand, P.C. and Saltin, B. (1961), "Oxygen uptake during the first minute of heavy exercise", J. Appl. Physiol.,16 : 971-976.
5. Bannister, R.G. (1960), "The structure and function of muscles", Ed-Broune G.H., Vol 2, Academic press.
6. Bassett DR Jr1 & Howley ET (2000), "Limiting factors for maximum oxygen uptake and determinants of endurance performance", Med Sci Sports Exerc. 32 (1): 70-84.
7. Bassett DR Jr1 & Howley ET (2000), "Limiting factors for maximum oxygen uptake and determinants of endurance performance", Med Sci Sports Exerc. 32 (1): 70-84.
8. Blomqvist, G. (1971), "Maximal oxygen uptake", N. Eng .J. Med., 284 : 1018-1022.
9. Clausen, J.P., Winand, J., and Trap-Jesen (1969), "Physical training in management of coronary artery disease", Circulation, 40 : 143-154.
10. Durin , J. U. G. A. (1797) , " The scientific basis of fitness and training in sports" basic book of sports medicine,1977, pp-40, Published by Olympic Solidarity of the international Olympic Committee.
11. Eugene, F. (1978), "Thermodynamics and life", Am. J. Physiol., 234 : R 81- R83.
12. Hagberb, J.M., Mullin, J.P. and Nagle, F.J. (1978), "Oxygen consumption during constant load exercise", J. Appl. Physiol., 45 : 381-384.
13. Heyward VH & Gibson AL (2014)' **"**Advanced fitness assessment and exercise prescription", 7th edition, Human Kinetics.
14. Horvath, M. S. (1979), "Review of energetic and blood flow in exercise", Diabetese, 28 (Suppl.1) :32-38.
15. Houmard JA (1991) **"**Impact of Reduced Training on Performance in Endurance Athletes", Sports Medicine, 12 (6): 380-393.
16. Kappagoda, C.J. and Newell, J.P. (1979), "A comparison of the oxygen consumption per body weight relationship obtained during submaximal exercise on a bicycle ergometer and on a treadmill", Quart. J. Exp. Physiol., 29 : 63-158.
17. McArdle WD, Katch FI & Katch VL (2001), "Exercise physiology: energy, nutrition and human performance", 5th edition. Williams & Williams, Baltimore.
18. Midgley AW, McNaughton LR & Jones AM (2007**), "**Training to Enhance the Physiological Determinants of Long-Distance Running Performance", Sports Medicine, 37 (10): 857-880.
19. Todd, A., Astorino, Robert, A. etal (2000), "Incidence Of The Oxygen Plateau at VO_2max During Exercise Testing To Volitional Fatigue", Official Journal of The American Society of Exercise Physiologists, Volume 3 Number 4, ISSN 1097-9751.