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Rate Pressure Product and VO_2max in young female athletes

KEYWORDS: VO_2max Rate Pressure Product [RPP] Female athletes

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ABSTRACT *Introduction: Regular physical activity is vital for good physical and mental health. Participation in athletic activity improves physical fitness, coordination and self discipline. VO_2max and RPP [rate pressure product] are non invasive techniques to measure the cardio-respiratory fitness. Measurement of these parameters will be helpful in promoting the sports activity in females.*

Aims and Objectives :The purpose of this study was to compare maximum oxygen uptake(VO_2 max) and rate pressure product(RPP) between young female athletes and non-athletes and to show the importance of regular exercise in females for physical fitness.

Material & Methods: The present study was carried out in 50 females between the age group of 18-22 yrs. They were divided into two groups, study group (25 athletes) and control group. (25 non-athletes) The VO_2 max was calculated by using Queen' college step .The rate pressure product(RPP) was calculated by multiplying heart rate and systolic blood pressure.The VO_2 max and RPP were compared between study group and controls.

Results: The VO_2 max levels were statistically higher in female athletes than non-athletes.The RPP levels were lower in female athletes as compared to controls. The decrease was statistically significant.

Conclusion :The present study showed VO_2 max levels more and RPP levels low in female athletes. Physical inactivity is seen among medical students due to sedentary lifestyle which may lead to many health problems. Our study concluded that regular exercise improves the physical fitness.

Introduction-

No matter what our age one should exercise daily. Healthy diet and regular exercise improve health as well as lower health care costs. Regular physical activity is vital for good physical and mental health.

Young females benefit a lot from physical activity. Exercise build and maintain healthy bones, muscles and joints. It helps to reduce risk for many chronic diseases like hypertension ,diabetes mellitus etc. Participation in athletic activity improves physical fitness, coordination and self discipline .Sport exposure encourages the development of motor skills, social skills, leadership and gives them opportunity to learn teamwork. Females who participate in sports have higher self-esteem and pride in themselves. In developing countries like India females are not that much aware of its importance as compared to western countries.

VO_2 max is a maximum rate of oxygen consumption as measured during incremental Exercise [1]. It is also called as Maximum Oxygen Consumption /Maximal Oxygen Uptake/ Peak Oxygen Uptake/ VO_2 max or aerobic capacity. Maximal oxygen uptake reflects the aerobic physical fitness of the individual. It is an important determinant of the endurance capacity during prolonged sub-maximal exercise. VO_2 max is expressed as an absolute rate liters of oxygen per kg of body mass per minute ml/(kg.min).VO_2 max is often used to compare the performance of endurance in sports athletes. [2]

Rate pressure product(RPP) is the product of pulse rate and systolic blood pressure. It is an index of myocardial oxygen consumption. [3] Rate pressure product is also called as cardiovascular product or double product. It is used in cardiology and exercise physiology to determine myocardial oxygen consumption. Myocardial oxygen consumption correlate highly with the work of the heart. Because of essentially aerobic metabolism of myocardium ,changes in MVO_2 correlate highly with the work of the heart. Thus Rate pressure product is used to measure workload on the heart to provide adequate blood supply to the myocardium during exercise in athletes. Rate pressure product increases with increased workload on the heart and reflects hemodynamic stress.[4] RPP is especially valuable and does not require expensive instrument or invasive monitoring and therefore applicable in intensive care units and trauma care units.

The present study investigated the rate pressure product and VO_2 max in female athletes by comparing them with non-athletes.

Aims and Objectives-

1) To determine the VO_2 max levels and Rate-pressure product levels in female athletes.

2) To compare the VO_2 max levels and RPP in female athletes with females having sedentary life-style.

Material and Methods-

This observational study was carried out in 50 females of age group between 18-22 yrs in Department of Physiology, Government Medical College, Aurangabad. Each female signed on informed consent before participating in the study. All the procedures and protocols were reviewed by the institutional ethical committee. Study group comprises 25 female athletes (n=25) .They were selected from Police Training Institute ,Cidco, Aurangabad . All the subjects

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in the study group were doing minimum 3 hrs exercise (like running, cycling, jogging etc.) daily since 2 years.Control group comprises 25 females(n=25) of same age group having sedentary lifestyle. They were not doing any type of exercise at all.

A detailed history was taken including personal history ,past history and menstrual history. The study was carried out during proliferative phase of menstrual cycle of all the females. General and detailed systemic examination was done of all subjects. The subjects having cardio-respiratory and neurological disorders were excluded from the study. BMI of the subjects were measured in all the participants.

BMI =Wt in Kg (Ht in m)²

Procedure for VO_2 max

All measurements were performed in a quiet and air-conditioned room.(24⁰c)The VO_2 max was determined 3 hrs. after meal. The VO_2 max was determined by using Queen's College Step

Test.[2] All the subjects were asked to warm up for 5-7 min (like brisk walking, stretching etc.) A wooden stepping bench of 16½inch was used along with metronome and stopwatch.

Metronome was set at the rate of 24 steps per min. The subjects were given a brief demonstration of the procedure. The subjects were asked to perform up and down stepping cycle for 3 min. After completion of test, pulse rate was measured for 15 sec. in standing position. This recovery pulse rate is converted to beats per minute.

Following equation is used to measure VO_2 max in females VO_2 max(ml/kg/min) = 65.81-(0.1847X step test PR/min) [2]

Procedure for Rate-Pressure Product

Rate-pressure product is the product of heart rate and systolic blood pressure RPP=Heart rate x Systolic blood pressure.[3]

Resting pulse rate was measured by examining radial pulse. We have taken three successive readings and then mean of it.

All the subjects were briefed about the procedure for recording of the blood pressure. After relaxation for 10 min. the resting blood pressure was recorded in the sitting position using a mercury sphygmomanometer and stethoscope by auscultatory method .Again we have taken three successive readings of blood pressure and then mean of it.

Rate pressure product was calculated as a product of heart rate and systolic blood pressure.[3]

Rate pressure product(RPP) = Systolic blood

pressure(SBP) x Heart rate(HR)

(mmof Hg.bpm) (mm of Hg) x (bpm)

Any total value of RPP greater than 10,000 indicates increased risk for heart diseases.[4]

The statistical analysis of this study was done by applying (unpaired 't' test) by using Microsoft Excel 2007 Software. P value of 0.05 was taken as significant.

Results-

In the present study female athletes showed statistically significant increased VO_2 max levels as compared to non-athletes in female athletes as compared to controls. The mean VO_2 max(ml/kg/min) levels in female athletes was 39.35 ±2.78.The mean VO_2 max (ml/kg/min)in females with sedentary life style was 24.02 ± 3.69. (Table no.1)

The levels of rate pressure product in female athletes were significantly lower in athletes than non-athletes. The mean value of RPP in female athletes was 7921.28±649.14 and the mean value of RPP in control group was 8652.50±810.69 (Table no.2)

Discussion-

In the present study female athletes showed significant increase in VO_2 max in female athletes as compared to controls.

The training of athletes include different exercises like running, jogging and stretching exercises regularly since 2 years .All these flexibility exercises such as stretching \improve range of muscle movements and joints. Aerobic processes are the main source of energy for muscles.[5] VO_2 max is the quantitative statement of individual 's capacity for aerobic transfer .In athletes high VO_2 max may be attributed to specific character of their training

High VO_2 max yields more energy and better athletic activity. Factors affecting VO_2 max are age ,gender ,heredity, body composition ,training state and exercise mode. Physiologically VO_2 max is the intensity of an individual to increase metabolic processes with the requirements of increased physical efforts.[6] This results due to transformation of chemical energy into mechanical mechanical one .[7,8] VO_2 max is the measure of aerobic capacity and determined as international standard of physical capacity. [7.8] It is expressed as liters of O_2/ min or ml of O_2 per kg of body wt/min.

Training increases VO_2 max by increasing the cardiac output secondary to high stroke volume .[9] Training also increases Arterio-venous oxygen difference . [9] Physical training increases VO_2 max 50% by increasing stroke volume and 50% increase is due to increased extraction of oxygen by working muscles which is reflected in an increased arterio-venous difference .The intense aerobic endurance training can induce considerable enlargement of all muscles with a change in cardiac configuration [9]

Training increases density of capillaries in skeletal muscles. This increased capacity to irrigate the muscles with blood lead to increased vascularization .[10]Training also results in

increase in no. of mitochondria with increased capacity to generate ATP aerobically by oxidative phosphorylation [11] VO_2 max increases cardio-respiratory fitness and it is the predictor of success in endurance events.[2]

Results of our study are found to be consistent with studies of Hermansen and Andersen [10] Amanda L. et al[11]. They found significant increase in VO_2 max in trained group as compared to untrained group .Amanda L. et al [11] reviewed VO_2 max and suggested physical training for improving VO_2 max.

In this study Rate pressure product levels of study subjects were decreased as compared to controls. RPP is the product of heart rate and systolic blood pressure ,is a good

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estimate of myocardial work or internal work done and is proportional to myocardial oxygen consumption.[12]

There was significant reduction in RPP after the training ,indicating that the left ventrical is performing less work and hence has O_2 consumption at rest. Besides training induced decrease in heart rate and systolic blood pressure, the reduction in double product may be due in part to training induction in total peripheral resistance,and hence reduced afterload. These findings suggest that low intensity exercise training decreases RPP and is consistent with previous findings.[13]

Results of our study are also consistent with Sea and Chase et al. They showed that training increases the RPP and VO2 Max levels in their study. The changes were due to changes in vagal tone and maximal oxygen consumption according to them.[14]

These results indicate that RPP, easily measurable variable is a valid predictor of MVO_2 during exercise.The RPP is critical in defining the response of the coronary circulation to myocardial metabolic demands.

Conclusion-The observed changes in our study confirm favourable physiologic adaptations and better health status as beneficial effects of regular exercise. Training improved the cardiovascular functional status. The knowledge can be adapted to improve cardiovascular and overall health status.

Table-1 Statistical analysis of VO_2 max (ml/kg/min) between female athletes and control Group.

Groups	Mean±S.D. (ml/kg/min)	' t ' value	' p ' value
Cases (n=25)	39.35 ±2.78	16.57	p<0.05
Controls (n=25)	24.02± 3.69		

Table-2 Statistical analysis of Rate Pressure Product (mm of Hg.bpm) between female athletes and control Group.

Groups	Mean ±S.D. (mm of Hg.bpm)	' t ' value	' p ' value
Cases (n=25)	7921.28±649.14	3.51	p<0.05
Controls (n=25)	8652.50±810.69		

REFERENCE 1.Rancovic G, Mutavdzic V, ToskicD ,Preilevic A,Kocic M.Aerobic capacity as an indicator in | diff. kinds of Sports. Bosnian J. Basic Medical Sciences 2010; 10(Suppl1): pp44-48. | | 2.Chapter 7. Mc Ardle WD, Katch FI . Nutrition and Energy Transfer, Essentials of exercise | physiology. 2nded 2000 :pp199-202. | | | 3. Chapter 12. Wylie and Churchill-Davidson's. A Practice of Anaesthesia.5th edition.P G | | PublishingPvt. Ltd.2000;pp417-418 | 4.Chapter 10.McArdle William.Cardiovascular system and exercise. Essentials of exercise | Physiology,Lippincott. Williams and Wilkins,3rdEdition; 2005.pp399-400 | 5. Kemper HCG. Activity and training in young athletes. Sports Wycznow.1992;5(Suppl 6) | :49-53. | 6. Radosław Laskowski, Ewa Ziemann, Tomasz Grzywacz. Comparison of aerobic capacity in | various groups of adolescent athletes.Archives of Budo 2009 ; (Suppl 5):21-25. | | 7. John F.Moxens ,Kjell Hausken .Comparing VO2 max Improvement in Five Training Methods. | Adv. Studies Theor.Phys 2012; 60 (Suppl 19): 931-957. | | 8. Steven A,.Hawkins R.A, Wiswell . Rate and Mechanism of Maximal Oxygen Consumption | Decline with Aging. Sports Med 2003 ;33(Suppl 12):877-888. | 9.Chapter 84. Guyton A.C, John E Hall. Textbook of medical physiology, 12thedition.Saunders | publication 2012: pp1038-1039. | 10. Hermansen , Andersen .Aerobic work capacity in young Norwegian men and women | J.Appl. Physiology.1965; 20(Suppl 3):425-431. | 11. Amanda L, Mageean ,R.P, Alexander C ,.M.Mier. Repeated Sprint Performance in Male and | Female College Athletes Matched for VO2 max Relative to Fat Free Mass .International | Journal of Exercise Science.2011; 4 (Suppl 4):229-237. | 12. F.L.Gobel, LA Norstorm,RRNelson ,CRJorgensen and Y Wang. The RPP as an index of | myocardial oxygen consumption during exercise in patients with angina | pectoris.Circulation.1978;57(Suppl 3):549-556. | 13. Nagpal S,Walia L,Lata H,Sood N, Ahuja GK. Effects of exercise on rate pressure product | in premenopausal and postmenopausal women with coronary artery disease. Indian J Physiol | Pharmacol .2007; 51(Suppl 3): 279-283. | 14. Seals D.R.,CHASE P.B.Influence of Physical Training on Heart Rate Variability and | Baroreflex Circulatory Control.J.Appl Physiol.1989; 66:1886-1895. |