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DETERMINATION OF AEROBIC POWER (VO2MAX) BY TRAEDMILL JOGGING TEST AND ASSESSMENT OF PHYSICAL FITNESS IN APPARENTLY HEALTHY YOUNG ADULTS.

Physiology

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ABSTRACT

AIMS AND OBJECTIVES

(i) to determine aerobic power (VO2max) by Treadmill jogging test (ii) to assess of physical fitness in apparently healthy young adults.

METHODS

Apparently healthy males (n=125) age (18 to 25 years) were included. Aerobic power (VO2max) was determined following the protocol of Treadmill jogging test. Physical fitness assessment was also done.

RESULTS

The predicted values of VO2max ranged from 40.51 to 51.17 ml/kg/min with mean ± SD 47.20 ± 2.27 ml/kg/min. The VO2max associated Physical fitness assessment scores of the test showed (superior in 0% (n=0) excellent in 68.0% (n=85), good in 28.0% (n=35) and fair in 4.0 % (n=5) amongst the participants.

CONCLUSION

Treadmill jogging test is an effective and safe method to determine the aerobic power (VO2max) in individual willing to participate in a fitness programme and to follow up the level of fitness in the course of training.

KEYWORDS

Vo_2max, Treadmill Jogging Test, Physical Fitness.

INTRODUCTION- Aerobic power is the maximum capacity of an individual to transport and utilize oxygen during incremental exercise, which reflects the physical fitness (PF) **[1]**. Fitness is the ability to maintain various internal equilibria as closely as possible to the resting state during strenuous exercise and to return back to baseline state promptly after cessation of activity **[2]**. Decrease in the physical activity (PA) significantly increased the risk of mortality from all causes **[3]**. PA and PF are inversely related to the mortality and the cardio-vascular (CV) disease risk factors **[4].** Higher levels of PF appear to delay all-cause mortality primarily due to lowered rates of CV diseases and cancer **[5].**Highly physically active individuals lived 2.1 years longer than their poorly active counterparts **[6-9].**

VO2max is widely accepted as the single best measure of maximal aerobic power. VO2max is internationally accepted parameter & is the first choice in measuring a person's aerobic power **[10]**. Those who are more fit have higher VO2max and can exercise more intensely and longer than those who are not as well conditioned.

Direct measurement of VO2max is restricted within a well-equipped laboratory. Moreover, it requires maximal exertion which is not advisable for compromised, debilitating and advancing cardio-respiratory diseased individuals.

Sub-maximal tests are similar to a VO2max test that do not reach the maximum limit of the respiratory and CV systems. In Sub-maximal test, extrapolation is used to estimate maximal capacity. Although it may be efficacious to use an exercise test requiring maximal efforts in young, fit and willing participants, sub-maximal exercise tests, which are relatively safer requires less time, are practical in a variety of settings.

Use of a treadmill as a mode of sub-maximal exercise testing is effective because (a) treadmills are readily available in laboratories; (b) jogging is a popular form of exercise and treadmills are often used as trial modality; (c) treadmill protocols are easy to administer and control (d) individualized programs can be based on the results of the treadmill jogging (TMJ) test **[11].** Treadmill jogging test based on multiple regression analysis provide submaximal, valid and convenient method of estemating VO2max **[12].**

The current study was designed to determine the aerobic power in terms of VO2max in apparently healthy young adults and to assess the physical fitness.

MATERIAL AND METHODS

One hundred twenty-five apparently healthy males were selected for the study after applying inclusion and exclusion criteria.

INCLUSION CRITERIA- Apparently healthy male subjects between 18 to 25 years of age, pre-exercise BP <140/90 mmHg and having a normal pre-exercise ECG were included in the study.

In addition, subjects had to fill a **Physical Activity Readiness (PAR-Q) [13]** Form before exercise. Subjects who had answered **NO** to all the questions were selected for the study.

EXCLUSION CRITERIA -Subjects with history suggestive of cardio-vascular, respiratory, metabolic, musculo-skeletal and emotional disorders were excluded.

EVALUATION -Informed written consent was taken from all the subjects. The study was approved by the Institutional Ethical Committee (IEC).

Subjects were divided into small groups and then they were familiarized with the instruments. Experimental protocol was explained to them in detail. They were also given a trial run on treadmill to relieve the anxiety related to the treadmill running during actual testing and data collection **[14].** For treadmill testing guidelines from American College of Sports Medicine (ACSM) were followed.

Height, weight, pre-exercise blood pressure and pre-exercise ECG were measured following standard procedures.

Weight was measured using calibrated weighing machine in light clothing and bare feet and height was measured using measuring scale in centimetres which was fixed to the wall.
Body mass index was calculated using Quetlet's index: BMI=Weight (kg) / height (m^2).

PC Based Stress Test Analysis (Stress-INVX1) system (CARDIVISION Exercise Stress Test System and Rest ECG Analysis System) was used for treadmill testing.

PROTOCOL

TREADMILL JOGGING TEST [15]

In this test subjects were made to walk at brisk walking speed at zero level grade for three minutes. This is followed by jogging at a sub-

maximal jogging speed between 4.3 and 7.5 mph at zero level grade until a steady state HR (two consecutive HR within 3 BPM 30 sec apart) was achieved. Heart rate, BP and RPE were recorded for walking and then for jogging stage.

The following equation was used to predict Vo_2max-

VO_2max = 54.07 + 7.062×gender [male= 1, female =0] - 0.1938×Weight [kg] + 4.47×speed [mph] – 0.1453× heart rate [BPM]

STATISTICAL ANALYSIS

The results were expressed as mean ± standard deviation (SD). A p value of < 0.05 was considered statistically significant.

Data analyses were performed on SPSS software (PSAW, Windows version 18.0).

RESULTS-

Anthropometric measurements of the participants are summarized in table-1.

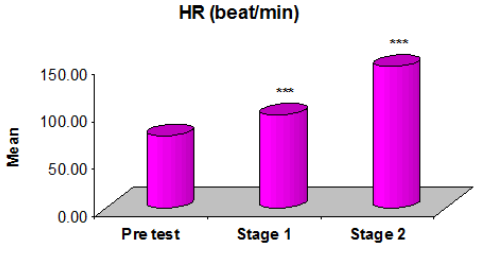
Table 1: Anthropometric Measurements of subjects -

Basic characteristics	Range	Statistic (mean ± SD)
Age (years)	18-25	21.17 ± 1.98
Height (cm)	162-187	172.26 ± 4.62
Weight (kg)	51-79	64.42 ± 6.19
BMI (kg/m2)	18.17-25.06	21.70 ± 1.79

Heart rate in different stages of the test is summarized in table 2 and figure-1

Table-2 Effect of Treadmill jogging test on heart rate (Mean ± SD, n=125) of subjects at different stages

Clinical parameters	Pre test	Stage I	Stage II	Net Change (pre to post exercise)	p value
HR(beats/min)	75.73 ± 3.18	97.49 ± 5.03	148.38 ± 11.16	72.66 ± 10.64	<0.001



***p<0.001- as compared to Pre test

Fig. 1. Pre-exercise and post-exercise mean HR of subjects during different stages of Treadmill jogging test.

The values of VO2max mean ± SD was 47.20 ± 2.27 ml/kg/min range from 40.51 to 51.17 ml/kg/min.

As VO2max is an indicator of health/fitness, a PF assessment was also done between two tests using criteria defined by The Physical Fitness Specialist Certification Manual, The Cooper Institute for Aerobics Research, Dallas TX, revised 1997 printed in Advance Fitness Assessment & Exercise Prescription, 3rd Edition, Vivian H. Heyward, 1998, p. 48. The PF assessment scores were estimated for 20-29 age groups as most of the subjects ranged between 20-29 age groups (76.8%)

The physical fitness assessment scores are summarised in table 3 and figure 2.

Table-3 Frequency distribution of PF assessment of subjects by Vo2max

PF assessment score	Treadmill jogging test (n=125) (%)
Fair	5 (4.0)
Good	35 (28.0)
Excellent	85 (68.0)
Superior	0 (0.0)

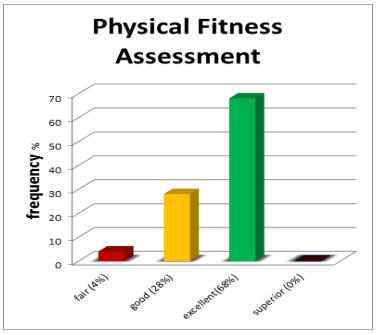


Fig-2 Distribution of Physical Fitness assessment of subjects

DISCUSSION- The importance of PF cannot be emphasized enough. The total amount of PA carried out by an individual is decreasing in amount day by day. Long standing decrease in PA is leading to more increase in the incidence and prevalence of the lifestyle diseases. Increase in the PA makes an individual more physically fit. Increase in the PF leads decrease risk of chronic disease as well as decrease in the mortality and morbidity associated with all causes. PF is not a static entity. It is in dynamic equilibrium with the PA. Those who are fit require PA to maintain their fitness and those who are currently unfit also require PA to increase their level of PF.

George JD, et.al. [12] developed a single stage submaximal TMJ test for estimation of VO2max. Multiple regression analysis [N=66] yielded the validation model with [radj-0.84 and SEE=3.2 ml.kg-1.min-1] Cross validation of treadmill jogging test comparing observed and estimated VO2max [N=63] resulted in [radj-0.88 and SEE=3.1 ml.kg-1.min-1]. They concluded that submaximal single stage TMJ test based on multiple regression analysis provide valid and convenient method of estemating VO2max. **Vehrs PR, et.al.[54] [11]** developed a single-stage submaximal TMJ test to predict VO2max in fit adults. Gender, age, body mass, steady-state HR, and jogging speed (mph) were included as independent variables in the multiple linear regression model to predict VO2max (*R*=0.91, standard error of estimate SEE= 2.52 mL.kg−1.min−1).They concluded that this simple TMJ test and its corresponding regression model provides a relatively safe, convenient, and accurate way to predict VO2max in fit adults, ages 18 to 40 years.

Koley S. [16] determined the values of VO2max from college going boys by Queen's college step test and reported VO_2max values 48.74±8.74 ml/kg/min. **Smilee JS, et al[26] [17]** predicted the value of VO2max using Astrand-Rhyming normogram in north Indian and south Indian male subjects exercising at submaximal workload on bicycle ergograph. VO2max values were 51.21 ± 7.20 ml/kg/min in north Indian vs. 49.19 ± 7.86 ml/kg/min in south Indian subjects were found. **Setty P, et. al [18]** determined the VO2max in young healthy male subjects by treadmill jogging test. The VO2max values were 48.90 ± 4.24 ml/kg/min. Comparing the VO2max values from our study 47.20 ± 2.27 ml/kg/min the small differences in values of VO2max may be apparent because all the tests are indirect and a small difference can be there due small error in prediction. They may be actual due to difference in fitness or genetic or socioeconomic or multi-factorial in nature.

Dasgupta PK, et.al. [19] determined VO2max in runners by maximal exercise test on treadmill. Values VO2max were 46.24±5.18 ml/kg/min short distance runners, 52.26 ± 2.8 ml/kg/min in medium distance runners and 51.03 ± 1.96 ml/kg/min in long distance runners. When compared to VO2max values from our study 47.20 ± 2.27 ml/kg/min**.** The higher values of VO2max in long and medium distance runners are due to effect of training. Lower values of VO2max in short distance runners because short distance runners utilize greater amount of energy from anaerobic than aerobic sources. So, their VO2max may not be high as compared to long and medium distance runners.

Looking at the VO2max prediction studies we conclude that the Treadmill jogging test used in our study gave values of VO2max that were not having a large difference for their matching counterpart studies.

CONCLUSIONS-

1. Treadmill jogging Test is a valid and safe method for the estimation of aerobic power (VO2max) in young adults.
2. Jogging is a popular form of exercise and treadmills are readily available in laboratories, can be employed for exercise prescription.
3. Assessment of physical fitness can be done using the submaximal exercise test that can be used as a baseline value in future training programme.
4. Health promotion policies & physical activity programs should be designed to improve physical fitness.

REFERENCES-

1. Hermansen L, Anderson LK. Aerobic work capacity in young Norwegian men and women. J Appl Physiol 1965; 20(3): 425-431.
2. Chawla K, Mishra R , Sachdeva V, Beenu. Correlation of antioxidants and fitness levels in undergraduate medical students. Indian J Physiol Pharmacol 2007; 51(3):293-295.
3. Lissner L, Bengtsson C, Björkelund C, Wedel H. Physical activity levels and changes in relation to longevity. Am.J.Epidemiol. 1996; 143:54-62.
4. Schnohr P, Parner J, Lange P. Joggers live longer. The Osterbro study. Ugeskr Laeger. 2001; 163:2633-2635. (in Danish, English abstract)
5. BlairSN; Kohl HW,Paffenbarger RS, Clark DG, Cooper KH, Gibbons LW. Physical Fitness and All-Cause Mortality A Prospective Study of Healthy Men and Women. JAMA. 1989;262(17):2395-2401.
6. Paffenbarger RS, Kampert JB, Lee IM, Hyde RT, Leung RW,Wing AL. Changes in physical activity and other lifeway patterns influencing longevity. Med.Sci.Sports Exerc. 1994; 26:857-865.
7. Paffenbarger RS, Hyde RT, Wing AL, Hsieh CC. Physical activity, all-cause mortality, and longevity of college alumni. N.Engl.J.Med. 1986; 314:605-613.
8. Paffenbarger RS, Hyde RT, Wing AL, Lee IM, Jung DL, Kampert JB. The association of changes in physical-activity level and other lifestyle characteristic with mortality among men. N.Engl.J.Med. 1993; 328:538-545.
9. Pekkanen J, Nissinen A, Marti B, Tuomilehto J, Punsar S, Karvonen MJ. Reduction of premature mortality by high physical activity: A 20-year follow-up of middle-aged Finnish men. Lancet. 1987; 1(8548):1473-1479.
10. Chatterjee S, Chatterjee P, Bandopadhyay A. Validity of Queen's College Step Test for estimation of maximal oxygen uptake in female students. Indian J Med Res.2005; 121: 32-35.
11. Vehrs PR, George JD, Fellingham GW, Plowman SA, Dustman-Allen K. Sub-maximal treadmill exercise test to predict VO2max in fit adults. Measurement in physical Education and Exercise 2007;11(2l): 61-72.
12. George JD, Vehrs PR, Allsen PE, Fellingham GW, Fisher AG, Development of submaximal treadmill jogging test for college fit individual, Med. Sci. Sports Exer.;1993:25(5):643-647.
13. Physical Activity Readiness Questionnaire [PAR-Q], Public Health Agency of Canada and the Canadian Society for Exercise Physiology, 2007.
14. Health-Related Physical Testing And Interpretation. In ACSM,s Guidelines For Exercise Testing And Prescription 7th edition 2006 Lippincott Williams & Wilkins; 68-69.
15. George JD, Vehrs PR, Allsen PE, Fellingham GW, Fisher AG, Development of sub-maximal treadmill jogging test for college fit individual, Med. Sci. Sports Exer.;1993:25(5):643-647.
16. Koley S. Association of Cardio respiratory Fitness, Body Composition and Blood Pressure in Collegiate Population of Amritsar, Punjab, India. The Internet Journal of Biological Anthropology. 2007 Volume 1 Number 1. DOI: 10.5580/560.
17. Smilee JS, Vivian ST. Comparative Study of Aerobic Power in North and South Indians. J Biomed Sci and Res., 2010: 2 (3),155-161.
18. Setty P, Padmanabha BV, Doddamani BR. Correlation between obesity and cardiorespiratory fitness. International Journal of Medical Science and Public Health.2013; 2(2); 298-302.
19. Dasgupta PK, Mukhopadhyay AK, De AK. A study of cardio-pulmonary efficiency in different categories of runners. Ind. J. Physiol. Pharmacol. 2000: 44(2): 220-224.