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Aerobic Fitness in Basketball Player- An Experimental Study in Central India

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Abstract
Introduction: *Aerobic fitness expresses the abilities of both cardio- respiratory and muscular systems to transport and utilize oxygen for energy. Fitness level of an individual depends on oxygen which can be transported by the body to working muscles to use that oxygen, hence maximum oxygen uptake capacity VO_2 max is widely considered to be reliable indicator of fitness.*
Aim and Objectives: *To assess the aerobic fitness and physiological parameters in young male basket ball players.*
Methodology: *Present study was conducted on 60 young adult male within the age group of 18-20 yrs. Group-A consisted of thirty male participants who played basket ball at least five times per week, for six month duration and Group-B consisted of thirty male participants who were control group and not engaged in any type of exercise. Parameters like VO_2 Max, Pulse Rate, Blood Pressure and BMI were analysed before and after six months in both the groups.*
Results: *Student's paired 't' test was used to compare results before and after six months in both the groups while Student's unpaired 't' test was used to compare results of basket ball players with that of control group. VO_2 max was increased while BMI, pulse rate and blood pressure was decreased in basket ball player group as compared to control group. $P < 0.05$ was considered statistically significant.*
Conclusion: *Basket ball players had increased values of VO_2 max, decreased pulse rate, blood pressure and BMI as compared to control group. This positive aerobic fitness and physiological outcomes of playing basket ball needs to be popularized among younger generations.*
Keywords: *VO_2 max, Basket Ball Players, Aerobic Fitness & Treadmill.*

Introduction

Aerobic fitness is related to a person's ability to perform dynamic, moderate-to-high intensity physical activity with large muscle groups for prolonged periods. Thus, it expresses the abilities of both cardio respiratory and muscular systems to transport and utilize oxygen for energy. It is one of the most fundamental measures of human physiology with remarkable health, wellbeing, life quality, work ability, and performance - related associations[(1,2)]. More persons now-a-days, are interested in 'physical fitness' than any time before.

Fitness level of an individual depends on oxygen which can be transported by the body to working muscles to use that oxygen, hence maximum oxygen uptake capacity (VO_2) max is widely considered to be reliable indicator of fitness[3,4]. Human body cannot survive without oxygen has been known since millennia. The work of A. V. Hill in 1920 an English physiologist first gained attention to the notion that oxygen, its delivery and subsequent metabolism by exercising muscles is crucial to prolonged activity. He considered the maximal oxygen uptake as the single best measure of cardio respiratory efficiency. Since then it has become an accepted way to measure cardio respiratory efficiency [5].

VO_2 max refers to the level of oxygen consumption beyond which no further increase in oxygen consumption occurs with further increase in the severity of exercise[6]. It is the highest rate of oxygen consumption attainable during maximal exercise. VO_2 max is expressed in litres or millilitres per minutes. However, the absolute value is highly affected by body weight so it is often expressed as ml/kg/minutes[7, 8]. VO_2max is widely accepted as the best measure of cardio-respiratory endurance. It measures aerobic capacity has been determined as the international standard of physical activity. VO_2 max can be determined using variety of exercises that activate the body's large muscle groups, provided the intensity and duration of effort are sufficient to maximize aerobic energy transfer. High VO_2 max requires integration of high levels of pulmonary, cardiovascular and neuromuscular function. So, VO_2 max is a fundamental measure of physiologic functional capacity for exercise[6].

Basketball is an internationally played team sport of which the outcome is determined by a variety of performance determinants[9,10,11,] .In addition to technical and tactical skills, basketball players need a high level of endurance, strength, speed, power, explosiveness, and agility. Basketball game can be classified as an intermittent physical activity due to the changing situational game conditions and the number of intervening variables. Intermittent performance depends on a combination of aerobic and anaerobic capacity making performance analysis substantially more complicated[12].

Aerobic fitness in basketball player is important to maintain a high level of activity during the entire game. It is necessary to have knowledge regarding aerobic fitness and physiological parameters of basketball players for more specific planning of the training of players. However, to our knowledge, there is little information available concerning the aerobic fitness of basketball players. Very few studies have reported direct estimation of VO_2 max. Based on this assumption, the purpose of the present study was to find out aerobic fitness via estimation of VO_2 max by direct method using metabolic analyser in basket ball players.

Material and Methods

Study setting: The study was carried out in Exercise Physiology lab, Dept of physiology J.N.M.C, Sawangi (M), Wardha after Institutional Scientific and Ethics Committee approval.

Study design- Experimental study

Study duration- One year

Sample size: Based on standard deviation taken from previously done study[13] sample size was calculated which came out to be sixty. Considering drop out, sample size kept was 10% more than expected . Participants were randomly selected by block randomization method and were assigned in two groups. Group-A consisted of thirty male participants who were taught basket ball and played at least five times per week, for six month duration while Group-B was control group consisted of thirty male participants who were not engaged in any type of exercise. All the participants were of age group 18-20 years. They were recruited from Datta Medical Institute and Medical College, Sawangi (M), Wardha.

Inclusion Criteria

1. 18-20 yrs male who were willing to play basket ball at least five times per week, for six months duration.
2. Participants who gave consent.

Exclusion Criteria

1. Subjects addicted to smoking and drinking.
2. Suffering from or diagnosed with any chronic diseases.
3. Subjects with COPD, cardiovascular disorder, hypertension or diabetes.
4. Major surgery in recent past subjects were excluded from study.

Study Protocol: Participants were explained about the detailed plan of work, aim of present research project and briefed regarding study protocol. Written informed consent was obtained from them. Participants of Group –A were trained under the guidance of certified basket ball trainer.

Measurement of parameters: Participants were familiarized with the laboratory environment and were given instructions about the experimental procedures prior to the day of recording of parameters. On the day of recording they were advised to abstain from tea, coffee and any medication 24hr prior to recording of parameters. The actual recording protocol included morning recordings after a light breakfast. All the parameters were recorded for both groups prior to the study and after six months completion of study.

BMI: Height without shoes was measured to the nearest 0.1cm using a standard meter. Body weight was measured using standard calibrated clinical weight scale in light indoor clothes to the nearest 0.1kg. Body Mass Index (BMI) = Weight in Kilograms (kg)/ (Height in meter) ^{2}

Pulse rate: The pulse was examined with three fingers of right hand over the subject's radial artery in a semi flexed wrist with distal finger obliterating the retrograde pulsations. The pulse rate counted for complete one minute. So also characteristic of pulse were assessed like rhythm of pulse, volume of pulse, force of the pulse, tension of the pulse, condition of the vessel wall, and equity on both the sides were examined.

Blood pressure- Measurement of blood pressure

Blood pressure in millimetre of mercury (Hg) was recorded with a sphygmomanometer (Diamond) placed in horizontal position. Subject in the sitting position were relaxed, right arm was exposed then after locating brachial pulse in antecubital fossa by an auscultatory method, at an interval of 15 minutes each and average of the three values were calculated.

Aerobic fitness: Aerobic fitness was assessed by VO_2 max. Participants were asked to perform the maximal graded exercise test (GXT) on a treadmill (PRECOR 9.1/9.2, Ambala). In treadmill GXT protocol participants were required to walk at a brisk pace at level grade for 3 min, followed by jogging at a self-selected speed at level grade (4.3–7.5 mph) for an additional 3 min [(14)]. Participants used hand signals to inform the test administrator when a comfortable jogging pace was achieved. Thereafter, the treadmill grade was increased 2.5% every min (treadmill speed remaining constant), until participants achieved volitional fatigue and were unable to continue despite verbal encouragement. HR-max was recorded as the highest observed heart rate during the final stages of the GXT. Open circuit calorimeter, using a mixing chamber configuration, was used to measure oxygen consumption (AD instrument). The highest full-minute oxygen uptake value observed during the final stages of the GXT was recorded as VO_2max. VO_2 values was considered maximal when at least two of the following three criteria were satisfied [(15)]: (a) Respiratory Expiration Ratio (RER) $\geq$ 1.1, (b) maximal heart rate of less than 15 bpm below age-predicted HR max (220–age) and (c) levelling off of VO_2 despite an increase in work. Statistical analysis was done by using descriptive and inferential statistics using Student's paired and unpaired 't' test. Software used in the analysis was SPSS 20.0 version. $P<0.05$ is considered as level of significance.

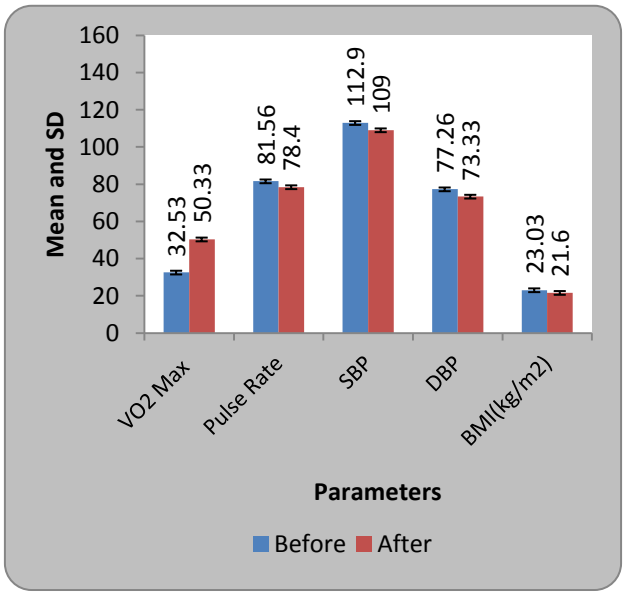
Observation & Results

By using Student's paired 't' test statistically significant difference was observed in mean VO_2 max, Pulse rate, SBP, DBP and BMI before and after six months in basket ball players as depicted in table-1 and graph -1.

Table 1 VO_2 Max, Pulse Rate, SBP, DBP, BMI: Basket ball players

Parameter	n	Before Mean± SD	After Mean± SD	t-value	p-value
VO_2 Max	30	32.53±3.01	50.33±2.36	27.04	P<0.001
Pulse Rate	30	81.56±4.46	78.40±4.46	8.81	P<0.001
SBP	30	112.90 ±5.64	109.00±5.03	6.54	P<0.001
DBP	30	77.26±2.99	73.33±4.14	7.68	P<0.001
BMI	30	23.03±1.82	21.60±1.47	7.54	P<0.001

Graph-1: Comparison of parameters before and after six months in basket ball players

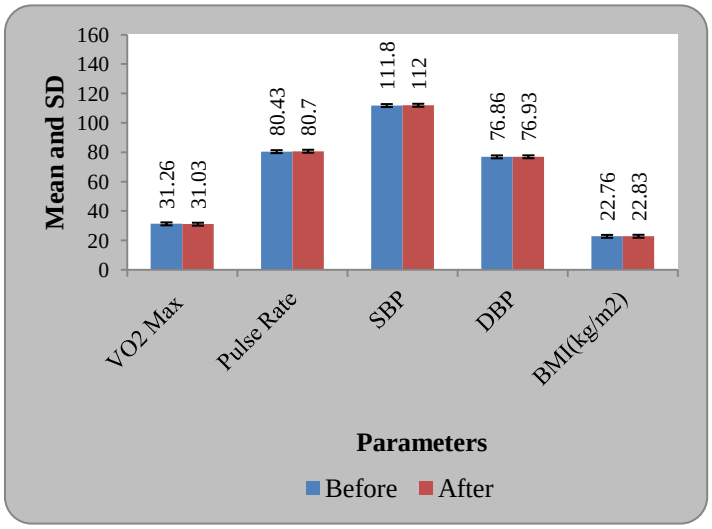


No statistically significant difference was found by using Student's paired 't' test in mean VO_2 max, Pulse rate, SBP, DBP and BMI before and after six months in control group as depicted in table-2 & graph -2.

Table 2 VO_2 max, Pulse rate, SBP, DBP, BMI: Control group

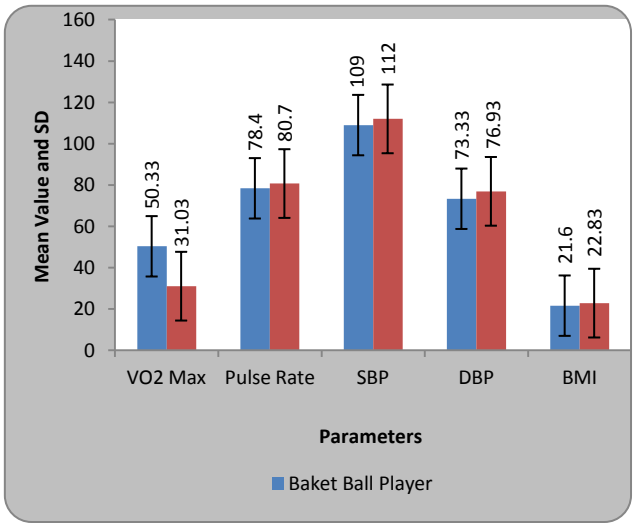
Parameter	n	Before Mean± SD	After Mean± SD	t-value	p-value
VO_2 Max	30	31.26±2.28	31.03 ±2.44	1.31	0.19
Pulse Rate	30	80.43±4.31	80.70±4.24	1.43	0.16
SBP	30	111.80±5.23	112.00±5.17	1.79	0.08
DBP	30	76.86±3.00	76.93±3.00	1.00	0.32
BMI	30	22.76±1.85	22.83±1.76	1.43	0.16

Graph 2 Comparison of parameters before and after six months in control group



By using Student's unpaired 't' test basket ball players had increased values of mean VO_2 max while decreased Pulse rate, SBP,DBP and BMI as compared to control group as depicted in graph -3.

Graph 3: Comparison of parameters after six months in basket ball players and control group



Discussion

Exercises in different forms, if performed regularly, have a beneficial effect on the various systems of the body. The modality of exercise that is most beneficial and economic for masses has now become the topic of research[16]. Positive physiological outcomes of exercise have important implications in the prevention of cardiovascular disease. Exercise as a lifestyle modification is beneficial to a wide variety of health conditions. The benefits of exercise have been promoted by a number of organizations and agencies including the American Heart Association, the American College of Sports Medicine, the Surgeon General of the United States, The National Institutes of Health, and the Centres for Disease Control [17].

The purpose of the present study was to gain insight into the aerobic fitness and physiological parameters of those participants who played basket ball. Results showed that those who played basket ball had increased values of Vo_2 max and decreased Pulse rate, SBP, DBP and BMI as compared to control group.

This increase in VO_2max with treadmill exercise is in line with the findings of Izumi T et al (1996) who studied the effects of moderate-intensity endurance and high-intensity intermittent training on anaerobic capacity and VO_2max in young male students. They concluded that 6 wk of moderate-intensity endurance training did not affect anaerobic capacity but that 6 wk of high-intensity intermittent training (20 sec exercise, 10 sec rest; intensity 170% VO_2max) improved both anaerobic capacity and VO_2max simultaneously[18] .

Effects of prolonged basketball skills training on maximal aerobic power was done by Vamvakoudis E et al. in 2007. Results of their study showed that the basketball players had lower heart rate values and higher VO_2 values as compared with that of controls. They suggested in order to improve the basic physical components, specific training procedures should be incorporated during the basketball training sessions and recommended that all children should be involved in some type of cardiovascular and resistance training program [19].

Mishra M in 2015 conducted a study to compare the maximum oxygen consumption of male players of different games. Results of their study showed that basket ball players had VO_2 max of 65.55 ml/kg/min[20].

Gupta R in 2015 did a study to find out effects of exercise training on VO_2 max and physiological parameters in young adult Indian males. Results of their study showed VO_2 max (ml/kg/min) was 43.2±4,BMI -23.7±4.9 ,pulse -82.7±6.2, systolic BP (mmHg) 123±4.86 and diastolic BP (mmHg) 79.9±5.66 in untrained subjects while trained subjects had VO_2 max of 61.2±6.2, BMI- 21.2±1.6, pulse - 77±5.5, systolic BP (mmHg) 108.56±8.55 and diastolic BP (mmHg) 69.63±5.53. They concluded that regular exercise training increases VO_2 max and physiological parameters [5].

These effects can be explained on the following basis-

Increase in VO_2 max may be due to hypertrophy of heart musculature resulting into larger stroke volume at rest and also lower resting pulse rate. These two factors lead to increase in VO_2 max in trained subjects [5].

It has been observed that both maximal cardiac output (stroke volume × heart rate) and maximal oxygen extraction by the tissues improves with physical training and both these parameters are important for the VO_2 max. Also low pulse rate and blood pressure can be explained on the basis that individuals with higher aerobic power maintain lower resting heart rates mainly via an increase in parasympathetic tone [21].

Whenever athlete go for anaerobic type of training his aerobic capacity is enhanced but along with this it is also observed that after anaerobic type of training the aerobic capacity of the athlete is also improved[20].

These positive outcomes in basketball players will be helpful for non basketball players to improve their VO_2 max and also will be beneficial to the sport coaches for deciding physical fitness on the basis of VO_2 max.

Limitations

Only male participants were included in the study. More number of samples with longer duration of study will definitely clear the results.

Conclusion

In present study, it was found that playing basket ball regularly can influence VO_2 max, Pulse rate , Blood pressure and BMI which in turn significantly affects the cardio respiratory system . The predominant influence is by improving the cardiovascular and aerobic capacity. The younger generation needs to be made aware to prevent the cardiovascular disease and obesity by engaging themselves in variety of exercises.

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