

# Cardiorespiratory Fitness of University Volleyball Players and Sedentary Young People in Marathwada Region of Maharashtra Province in India

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## ABSTRACT

**Background:** Volleyball is considered a physically demanding athletic sport; characterized by rapid acceleration, deceleration, and sudden changes of direction. It has been highlighted that aerobic capacity ( $VO_2$  max) which indicates cardiorespiratory fitness has a significant effect on the performance of athletes and is an important element of success in sports.

**Aim and Objective:** The objective of this study was to compare aerobic capacity of university volleyball players from the region with that of matched sedentary controls. The secondary objective was to compare the findings with the aerobic capacity data reported in literature for the volleyball players and sedentary population.

**Materials and Methods:** Sample size was calculated for

detecting a large effect size (Cohen's  $d = 0.8$ ) with  $\alpha$  as 0.05 and power of study as 80% for two tailed hypothesis testing. By using Queen's college step test,  $VO_2$  max was measured in 30 male volleyball players in the age group of 20 to 25 years and was compared with 30 age and socio-economic status matched controls with sedentary lifestyle.

**Results:** The mean predicted  $VO_2$  max was  $52.99 \pm 5.13$  ml/kg/min in volleyball players and  $37.01 \pm 3.94$  ml/kg/min in controls. The difference in mean values of  $VO_2$  max (ml/kg/min) in volleyball players and controls was statistically highly significant with p-value less than 0.001.

**Conclusion:** The volleyball players showed a superior aerobic capacity compared with age and socio-economic status matched controls with sedentary lifestyle.

**Keywords:** Aerobic capacity, Queen's college step test, Sedentary lifestyle

## INTRODUCTION

Volleyball is among the most popular games played all over the world. It is the game which demands power, agility as well as high speed [1]. The evaluation of aerobic capacity ( $VO_2$  max) gives the information regarding the player's health status, helps in evaluating the effects of training and has been found to play a role in the early selection of athletes [2]. It is an index of the ability of body's circulatory and respiratory system to supply fuel and oxygen during sustained physical activity [3]. It has been highlighted by earlier studies that there is scarcity of published data on physiological profile of volleyball players from India [4,5]. The assessment of aerobic capacity and its comparison with sedentary population may signify the training status of players and also reflect on the overall physical fitness of the players. With this perspective, this study is an attempt to evaluate the aerobic capacity ( $VO_2$  max) in University volleyball players and compare it with sedentary controls.

## MATERIALS AND METHODS

The Study was conducted in G.D.C Aurangabad, India during June 2012 to December 2012.

**Selection of the Subjects:** Sample size was calculated using A-priori Sample Size Calculator for Student t-Tests software [6] for detecting a large effect size (Cohen's  $d = 0.8$ ) with  $\alpha$  as 0.05 and power of study as 80% for two tailed hypothesis testing. Thirty male University Volleyball players in the age group of 20 to 25 years were recruited. Subjects with history of chronic diseases and addiction were excluded. Thirty male individuals in the age group of 20 to 25 years were recruited as control group from the friends and relatives of the players while taking care that they belonged to same socioeconomic group. They were having a sedentary lifestyle (not exercising more than 20 minutes on 3 or more days a week) with no involvement in any athletic activity or yoga. Individuals having history

of any chronic disease or addiction, history of trauma or injury were excluded from the study.

All the subjects and controls were provided information regarding the nature of the study and the detailed procedure of the study was explained to them. Written informed consent was taken from all the participants. The approval of the study protocol was obtained from the Institutional Ethics Committee prior to commencement of the study.

**Basic Data Collection:** The subjects and controls were called early in the morning between 9 am & 10 am with light breakfast. They were advised to follow their regular sleep timings and to avoid vigorous exercise 48 hours prior to collection of data.

Body Weight was measured with the help of weighing machine after proper calibration. Subjects were asked to come in light clothing. Height measurement was done using the height scale which was fixed to the wall.

**Assessment of  $VO_2$  max.:** Queen's college step test was used for the indirect estimation of maximal aerobic capacity by the method validated for young Indian men by Chatterjee S et al., [7].

Bench stepping sub-maximal exercise for males was used as per protocol. Before the test, subjects were asked to perform 5 to 7 minutes of warm up exercises consisting of lower limb stretching & brisk walking. Wooden bench of height 16.25 inches was used for the test. Stop watch was used to monitor the timings. A Metronome was utilized to measure the stepping cadence set at 96 beats per min. i.e. 24 complete steps for males. The step test was done after a brief period of demonstration and all the subjects performed the test for complete three minutes. After completing the test, subjects remained standing and their carotid pulse rate was measured during 5<sup>th</sup> to 20<sup>th</sup> seconds into recovery period.

Fifteen seconds Recovery heart rate (HR) was converted as beats per minute (15 second HR x 4).

**Following formula was used for determining VO<sub>2</sub>max:** VO<sub>2</sub>max = 111.33 – (0.42 X Pulse Rate per minute) [7,8]

For each parameter, the mean value and standard deviation were calculated. Unpaired t-test was applied for statistical significance. All the calculations and statistics were done using online GraphPad (GraphPad Software Inc. California, USA). A p-value of less than 0.05 was considered to be statistically significant. A p-value of less than 0.001 was considered to be statistically highly significant.

## RESULTS

The mean values for the age, body weight and height in volleyball players and controls are described in [Table/Fig-1]. The mean predicted VO<sub>2</sub>max in volleyball players and controls and the analysis results are described in [Table/Fig-2].

Parameter	Subjects (n=30) (Mean ± SD)	Controls (n=30) (Mean ± SD)
Age (years)	22.3 ± 1.34	22.2 ± 1.12
Weight (kilograms)	54.9 ± 3.39	55.13 ± 3.13
Height (meters)	1.73 ± 0.04	1.72 ± 0.02

**[Table/Fig-1]:** Baseline Characteristics  
SD: Standard Deviation

Parameter	Volleyball Players (Mean ± SD)	Controls (Mean ± SD)	p-value
Recovery Heart Rate(per minute)	138 ± 12.15	176.93 ± 9.37	<0.001**
VO <sub>2</sub> max (ml/kg/min)	52.99 ± 5.13	37.01 ± 3.94	<0.001**

**[Table/Fig-2]:** Comparison of VO<sub>2</sub> max in the Study Groups  
\*\* p < 0.001: statistically highly significant, SD: Standard Deviation

## DISCUSSION

The mean predicted VO<sub>2</sub>max was 37.01 ± 3.94 ml/kg/min in controls with sedentary lifestyle. The results are in line with that reported by Verma SK et al., [9] and as highlighted by them, the VO<sub>2</sub>max values in sedentary population from our country are probably the lowest in comparison with the similar reports in literature. When compared with reports from the developed countries like United States of America by Taylor et al., [10], Germany by Koniz et al., 1961 [11], Great Britain by Davies et al., [12] and Canada by Robinson et al., [13], the mean value of VO<sub>2</sub>max of our young sedentary subjects was found to be lower by around 12 to 35%. Lower VO<sub>2</sub> max in study subjects as compared to sedentary boys from other countries maybe due to factors like nutritional status, environmental factors and genetic factors [9].

High level of aerobic capacity is indispensable for achieving success in many sports; therefore, the determination of VO<sub>2</sub> max is of special importance as it plays the key role in professional sports and it is the reflection of any athlete's physical capability [1]. The mean predicted VO<sub>2</sub>max was 52.99 ± 5.13 ml/kg/min in volleyball players in our study. The results are in line with that reported by Verma SK et al.,

[9] and again as highlighted by them, the VO<sub>2</sub>max values in volleyball players from our country are probably the lowest in comparison with the similar reports in literature. Therefore they suggested that any successes of the Indian teams may be attributed to their higher levels of skill rather than to their VO<sub>2</sub>max which further strengthens the need to improve the physical fitness standards of our athletes. The mean VO<sub>2</sub>max for Volleyball players in an earlier study from Maharashtra was found to be 44.55 ml/kg/min [1]. However, Smith DJ et al., [14] have reported VO<sub>2</sub>max of 56.7 ml/kg/min in Canadian national volleyball team players. Thus, the aerobic capacity of players from our region falls on the lower side. The limitation of the present study was the small sample size of subjects. So, it is important to replicate and extend our observations to large population.

## CONCLUSION

Thus the present study showed a superior VO<sub>2</sub>max in volleyball players as compared to normal control group, but still it is far less than International standards. Further research is needed to study the physical and physiological characteristics of Indian volleyball players and compare it with international standards.

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