

Original Research Article

## Estimation of VO<sub>2</sub> max before and after Yoga Training in Healthy female Medical Students

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**Abstract:** Exercise is one of the methods used by physiologists to understand the functioning of various systems of the body. Recent advances in understanding the physiology of exercise have shown that regular physical activity enhances general well-being, promote health and prevent many diseases. Yoga is one of the methods of training and it is generally agreed that yoga performance enhance the health and function of respiratory system. This study was conducted in KMC Warangal on healthy female medical students. VO<sub>2</sub> max was measured by using Bruce Treadmill Test which is an indirect to estimate VO<sub>2</sub> max. For female VO<sub>2</sub> max = 4.38 x T - 3.9 T = Total time on the treadmill measured in fraction of a minute. Changes were recorded prior to and after training in yoga in a group of 60 female Healthy medical students. The Average VO<sub>2</sub> max in control group was 31.90 ml/Kg/min and study group it was 32.16 ml/Kg/min. After the study group undergo continuous yoga training for 90 days under trained yoga teacher the VO<sub>2</sub> max in the control group showed negligible change whereas the Average VO<sub>2</sub> max in the Study group increased to 38.46 ml/Kg/min which was significant. The study demonstrates that yoga training improves the maximal oxygen consumption of the body. There is beneficial effect of yoga on respiratory system in females. Yoga training in general improves exercise tolerance in females when practiced regularly.

**Keywords:** VO<sub>2</sub> max, Yoga, Female.

### INTRODUCTION

Recent advancements in understanding physiology of exercise have shown that regular physical activity promote health and prevent many diseases. Yoga is an ancient system of Indian philosophy. It has been practiced for health and well-being. Several researches have shown that regular practice of yoga improves health and well-being [1-4]. The word “yoga” comes from a Sanskrit root “yuj” which means union, or yoke, to join, and to direct and concentrate one's attention [5, 6]. Many studies in past have shown the beneficial effects of yoga and regular practice of yoga promotes physical and mental well-being [7, 8]. Sustained yoga practice leads to stimulation of parasympathetic tone and reduction in blood pressure, heart rate [9]. Studies have shown that yoga increases hemoglobin levels and allows for more oxygen to be transported thus enhancing the function of RBC [8]. Yoga also contributes in decreasing viscosity of blood, the twisting poses adopted during various yoga practice increases venous return from internal organs and

allows oxygenated blood flow to these areas it also improves maximum uptake and utilization of oxygen during exercise. [10,11]. Oxygen consumption refers to the process of an individual breathing in oxygen, transporting it to the working muscle, and using it to generate energy aerobically [12]. During exercise, the oxygen that is brought in and utilized allows the body to meet the energy demands of the specific level of exercise intensity. As a result, this concept has become one of much interest in the field of exercise physiology, particularly maximal oxygen consumption. Maximal oxygen consumption, or VO<sub>2</sub>max, is the maximal amount of oxygen an individual can bring in and utilize during exercise [13]. Measuring maximal oxygen consumption (VO<sub>2</sub>max) via treadmill testing is a popular procedure for testing an individual's cardiopulmonary function and providing subsequent information for the design of exercise prescription or exercises training [14]. This type of test is commonly used for endurance athletics to determine the cardiopulmonary capacity prior to training. The

physiological information that can be obtained from this VO2 max test can be used to identify improvements in cardio respiratory systems [15]. With this background we tried to evaluate improvements in VO2 Max in healthy females.

**MATERIALS AND METHODS**

This study compares the effect of yoga on VO2 max of young untrained Medical College students. In this study about 60 healthy disease free female medical students (aged 18 -24 years) were selected, they were divided in to two groups of 30 each randomly, the first group was designated as the Control Group the second group was designated as the Study Group. The control group measurements of VO2 max were taken before the start of study. They were asked to follow their routine activities without involving in any extra exercise or training for 3 months and again values of VO2 max were taken at the end of three months for comparison. The study group measurements were taken before the start of yoga training. Then they were given Yoga training under a trained yoga teacher for 60 minutes each day for 3 months then VO2 measurements were recorded. After 3 months the VO2 max of both control and the study group was measured. VO2 max was measured using Bruce Treadmill Test which is an indirect test that estimates VO2 max using a formula

For female VO2 Max = 4.38 x T - 3.9 (T = total time on the treadmill measured in fraction of a minute). A motorized treadmill Afton company with a speed ranges from 1 - 11/ Kmph was used for the study. Although the most precise method of measuring VO2 max is by analysis of expired air during a maximal laboratory exercise test but, this is not always possible in which case the indirect Test is used.

Collected data was entered in the Microsoft Word Excel Sheet 2007 version and the data obtained were analyzed using the SPSS (Statistical Package for the Social Sciences) 17 Version. The study was approved by Ethical Committee of Kakatiya Medical College Warangal; all the participants were willing voluntarily to participate in the study. The complete study design was explained to all the participants. A written consent was obtained.

**RESULTS**

The values of VO2 max recorded in Control Group who were only involved in normal routine activity were recorded prior to start of the study and After the End of the study which was of duration of 3 months. However this group as it was acting like control they did not underwent any Yoga training. The mean value of parameters are shown in the Chart 1.

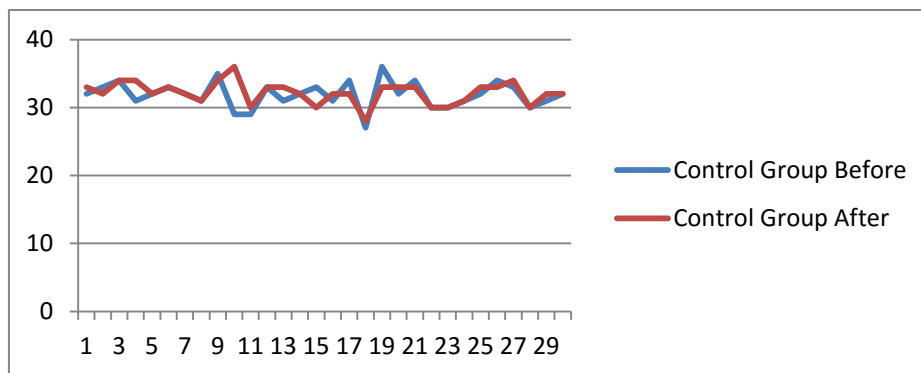


Chart- 1: Values of VO2 max in ml/Kg/min of control group before and after 3 months

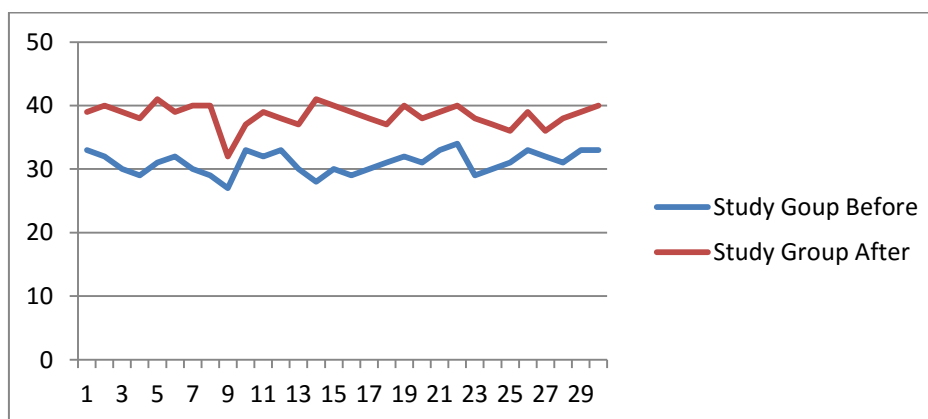


Chart- 2: Values of VO2 max in ml/Kg/min in study group before and after Yoga training for 3 months

The chart 2 depicts the values of parameters recorded in the second group called the Study group which included 30 healthy female medical students. The

value of parameters recorded before the beginning of yoga training and after 3 months of regular training in yoga.

**Table- 1: Comparison of Maximal Oxygen uptake VO<sub>2</sub> max (ml/kg/min) uptake between control and study groups before and after 3 months of study**

Group	Training	Mean VO <sub>2</sub> Max ml/kg/min	SD	SE	p value	Results
Control Group	Before	31.9	3.4	5.35	> 0.05	Not Significant
	After	32.16	3.7			
Study Group	Before	31.03	2.51	1.15	<0.05	Significant
	After	38.46	2.9			

The comparison of the values of VO<sub>2</sub> max recorded in both group prior to and the end of the study were compared as it is shown in table 1 the mean values of parameters did not change significantly in the control group prior to and at the end of the study. However the mean values of VO<sub>2</sub> max improved significantly in study group at the end of regular yoga training.

**DISCUSSION**

The VO<sub>2</sub> max test has become a corner stone in clinical and applied physiology involving physical exercise. Their applications are numerous ranging from elite athlete test to individuals with several pathological conditions [16]. Despite studies long periods of study on VO<sub>2</sub> max there are several questions raised in particular to the methods used for the VO<sub>2</sub> max measurement [17]. Coming to the facts of Oxygen transport, Oxygen consumption can be divided into three phases: oxygen intake, oxygen transport, and oxygen utilization, and the efficiency of each phase depend on a host of physiological systems within the body [18, 19]. Oxygen intake is the actual breathing in of oxygen from the ambient environment into the lungs. Oxygen transport is the diffusion of the oxygen from the lungs into the blood, where it travels through the circulatory system to the site of the working muscle and is delivered via capillaries. Oxygen utilization is the muscle’s ability to take the oxygen and use it to generate energy through the aerobic metabolic pathways. The rate at which these processes can occur during exercise depends largely on the capacity of the heart, lungs, and blood to transport the oxygen to the working muscle, as well as the muscle’s ability to extract the oxygen for use in metabolism [20]. The rate of oxygen consumption is therefore dependent upon the development of the cardiovascular and pulmonary systems, and as a result, maximal oxygen consumption has become a key indicator of cardiovascular fitness. [20]. In the present study it was found that Yoga training improves VO<sub>2</sub> max in females. Other similar studies in the past have also shown that the regular training of yoga has caused improvement in VO<sub>2</sub> max. [21] Raju *et al.*; found that significant reduction of post exercise minute ventilation and oxygen consumption after 90 days of yoga training [22]. Bouchard and

Malina showed that up to 60% of variance in physical fitness is attributed to environmental and behavioral factors [23]. Study by Catherine Woodward shows that yogic practices enhance muscular strength and body flexibility, promote and improve respiratory and cardiovascular function, and enhance overall well-being and quality of life [1]. In a similar setting by Ganguly SK has shown that short term yoga training produced several beneficial effects on cardiovascular efficiency of subjects [24]. Regular yoga practices probably cause prolong stimulation of parasympathetic tone, in addition it increases the ability of muscles to utilize more oxygen. Which may be due to postures adopted in yoga practice, better agility of muscles and better utilization of oxygen due to increase in activity of oxidative enzymes [4-9].

**CONCLUSIONS**

Within the limitation of the present study it was found that regular Yoga training for 3 months improves the VO<sub>2</sub> max in females. This shows that Yoga improves the Cardiovascular and Respiratory parameters and also improves spiritual well-being. Thus the beneficial effect of yoga on various systems may be due to certain postures and exercises which also include breathing techniques. Therefore Yoga can be safely recommended to improve the overall health and well-being of people.

**Conflict of interest:** None

**Source of Support:** Nil

**Ethical Permission:** Obtained

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