

A Study of VO_2 Max and Body Fat Percentage in Female Athletes

ANJALI N. SHETE¹, SMITA S. BUTE², P.R.DESHMUKH³

ABSTRACT

Introduction: Aerobic capacity of athletes is an important element of success in sports achievements. It is generally considered the best indicator of cardio respiratory endurance and athletic fitness. Body fat percentage affects VO_2 max and thus the cardiovascular status of the athletes. The present study was undertaken to assess the VO_2 max and body fat percentage in athletes. The secondary objective of the study was to study the relationship between VO_2 max and body fat percentage.

Materials and Methods: Twenty five female athletes of age group 17-22 years were selected for the study. VO_2 max was determined by Queen's college step test and body fat percentage by skin fold calipers. The VO_2 max and body fat percentage were determined in non athletes of same age group for comparison. The statistical

analysis was done by Student's t-test and Pearson correlation test.

Observation and Results: The mean VO_2 max in athletic group was 39.62 ± 2.80 ml/kg/min. In non-athletic group, VO_2 max was 23.54 ± 3.26 ml/kg/min. The mean body fat percentage in athletes was $24.11 \pm 1.83\%$ and in non-athletes it was $29.31 \pm 3.86\%$. The difference in VO_2 max and body fat percentage was statistically significant in our study. The VO_2 max and body fat percentage in both the groups showed negative correlation by Pearson test but, was not statistically significant.

Conclusion: The present study showed a statistically significant higher VO_2 max in female athletes. The study showed a negative correlation between VO_2 max and body fat percentage but was not statistically significant.

Keywords: Body fat percentage, Female athletes, VO_2 max

INTRODUCTION

Aerobic capacity of athletes is an important element of success in sports achievements. VO_2 max refers to the intensity of aerobic process and actually denotes the maximum capacity to transport and utilize oxygen during exercise done at increasing intensity. VO_2 max is the highest rate of oxygen consumption attainable during maximal exercise [1]. It reflects physical fitness of an individual having athletic capacity. Maximal oxygen uptake as a measure of aerobic capacity has been determined as the international standard of physical activity [2]. The basic unit of measuring the maximal oxygen uptake is its absolute value expressed in liters or milliliters per minutes. However, the absolute value is highly affected by body weight; so it is often expressed as milliliter /kg/minutes. The reduction in the physical activity affects body composition factors like body fat percentage, body mass index and body muscle mass. There are close relationships between the body composition factors and aerobic, cardiovascular fitness. With decrease in body fatness, there is increase in aerobic fitness [3]. Recent studies suggest that even in young, physically, highly active men with an obviously optimal lifestyle; a lower BMI is associated with more risk profile for vascular disease. For young, active sportspersons all these factors are concerned for their cardiovascular risk profile [4].

In the recent decade, decline in physical activity among young adults has been observed. Regular physical activity is an important part of a healthy lifestyle. It is associated with decreased risk of heart disease, obesity and lower levels of stress [5]. There is alarming decline in physical activity among college students. Based on self reported height and weight; approximately 35% of young adults are overweight or obese [6]. Keeping all these factors in mind, the primary aim of our study was to assess the aerobic capacity of the female athletes and non-athletes. The study also assessed the relation of VO_2 max and body fat percentage in both the groups. It is a pilot study which attempts to give an idea regarding the physical

fitness of female athletes as very few studies are there in female sportspersons.

MATERIALS AND METHODS

Female athletes doing regular exercises in the police training institute from the city in the age group of 17-22 years, who have been doing regular exercise for more than two years were selected as subjects. Age matched female students of the Government Medical College, Aurangabad not doing any type of exercise were selected as control group for comparison.

All the subjects and control were well explained about the nature of the study and the detailed procedure of the study. Consent was taken from all of the participant. A detailed history was taken which included their personal history, menstrual history, past history and family history. The information was entered on a proforma given to each subject. Thorough General Examination was done. Then a detailed systemic examination of the cardiovascular, respiratory, abdomen and central nervous system was also done. The detail history was taken to exclude the cases with any major illnesses.

Basic Data Collection

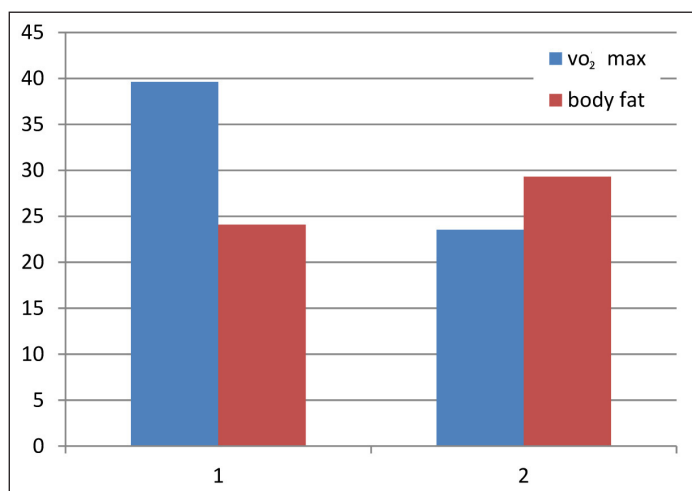
The subjects and control were called early in the morning. Following measurements were done in a well-lit room of the Department of Physiology in the medical college. Body weight: measured by standard weighing machine. Standard Height: taken by measuring tape.

Body Mass Index

It was calculated as – Body Mass Index (BMI) = Weight in Kilograms (kg)/ (Height in meter)² Determination of VO_2 max: Subjects were asked to come three hours after their meal. They were asked not to indulge in any kind of vigorous exercise within 48 h prior to the test. They were asked to wear comfortable clothing. Queens

Groups	Vo ₂ max ml/kg/min Mean ± S.D.	Body Fat % Mean ± S.D.	
Female Athletes n= 25	39.62 ± 2.80**	24.11± 1.83**	p< 0.0001
Female Non-Athletes n= 25	23.54 ± 3.26	29.31 ± 3.86	

[Table/Fig-1]: VO₂ Max and body Fat %
n= number of sample **= highly significant



[Table/Fig-2]: Showing VO₂ Max and body fat percentage

Groups	Vo ₂ max ml/kg/min Mean ± S.D.	Body Fat % Mean ± S.D.	Pearson Correlation
Female Athletes n= 25	39.62 ± 2.80	24.11 ± 1.83	R= -0.1191 ns
Female non-athletes n= 25	23.54 ± 3.26	29.31 ± 3.86	R= -1034 ns

[Table/Fig-3]: Correlation of VO₂ Max and body Fat %
n= number of sample ns= not significant

College Step Test was used to predict maximal aerobic capacity. It is a standard method to measure one's maximal oxygen uptake using sub maximal exercise in the form of bench stepping, suitable for adults. Prior to the test, subjects were asked to warm up for 5-7 min consisting of brisk walking and stretching of lower limb muscles. A wooden stepping bench of 16¼ inch was used along with metronome and stop watch. Metronome was used to monitor the stepping cadence, which was set at 96 beats per minute (24 complete steps per minute). The step test began after a brief demonstration and practice period. The subjects were asked to perform each stepping cycle to a four step cadence, up-up- down-down continuously for 3 min. After completion of test, subjects remained standing while pulse rate (carotid or radial artery) was measured for 15 sec, from 5th to 20th second of the recovery period. Fifteen second Recovery heart rate was converted to be expressed as beats per minute (15 sec Heart Rate x 4)[7] Following equation is used: VO₂ max (ml/kg/min)= 65.81-(0.1847× step test PR) /min.

Body Fat Testing with Skin fold Calipers

The skin fold caliper is a device which measures the thickness of a fold of your skin with its underlying layer of fat by doing this at the key locations can be a quite accurate representative of the total amount of fat that is on your body it is also possible to estimate the total percent of body fat on your body. If you are right handed, pull out the fold of skin with the underlying layer of fat with your left hand and hold it with the fingers of the left hand. Then with the calipers in your right hand, place the jaws of the calipers. The jaws of the calipers should be about ¼ (7.5 mm) from the fingers of your left hand which continues to hold the fold of skin. Release the triggers of the calipers of the entire force of the jaws is on the skin fold. Do not release the fingers of the left hand while taking the readings. The readings are mentioned in mm.

Where to Take the Measurements

Back of the arm (triceps): Centre of the arm.

Front of the arm (Biceps): Centre of the arm.

Shoulder Blade: Sub Scapular

Waist: Waist (Supra iliac). This is located just above the iliac crest. The protrusion of the hip bone, a little towards the front from the side of the waist. There are Charts to Calculate Body fat Percentage [8]

STATISTICAL ANALYSIS

The VO₂max was analysed by student t-test. The p<0.0001 was taken as significant. Pearson correlation test was computed for correlation between VO₂max and body fat percentage. p-value of 0.05 was taken as statistically significant.

RESULTS

The mean VO₂max in female athletes was 39.62 ± 2.80 ml/kg/min and the mean VO₂max in female non athletes was 23.54± 3.26 ml/kg/min. The difference in VO₂max of female athletes and non athletes was statistically highly significant [Table/Fig-1&2].

The mean body fat percentage in athletes was 24.11±1.83% and in non athletes was 29.31± 3.86%. The difference was statistically highly significant [Table/Fig-1&2].

We computed Pearson correlation test for assessing the relation between VO₂max and body fat percentage. In both the groups; it showed negative correlation but it was not statistically significant [Table/Fig-3].

DISCUSSION

The present study showed a significant higher level of VO₂ max in female athletes than female non-athletes. It also showed a significant difference in body fat percentage when compared in athletes and non-athletes.

Aerobic capacity is an integral of functional capacities of all systems involved in supply, transportation and energetic oxygen transformation [9]. Functional impairment of any link in the chain can to some extent influence the decrease in the level of athlete's physical capacity [10]. Training increases VO₂ max by increasing the cardiac output, secondary to high stroke volume and an increase in A-V oxygen difference. It appears that physical training increases the VO₂ max by about 50% and rest 50% due to increased extraction of oxygen by working muscle [11]. Apart from this, enlargement of cardiac chambers, increased density of capillaries, increase in number of mitochondria and hypertrophy of muscle fibers all contribute to the increased VO₂ max in athletes [12].

There are various studies in which similar results were shown. Goran Rankovic [1] in his study concluded a statistically significant higher VO₂ max in athletes as compared to non-athletes. Christie CJ et al., [13] also recorded similar findings in his study. Vamvakoudis et al., [14] also reported a higher VO₂ max in basketball players as compared to control group. The secondary objective of our study was to assess the correlation of VO₂ max and body fat percentage. When we analysed the results; in both athletic and non-athletic group, there was a negative correlation but it was not statistically significant. Our study was in accordance with Goran [15] who reported impaired VO₂ max in overweight and obese individuals which was not significant. There are studies showing no relation between VO₂max and body composition [16-23]. Whereas, Pibris et al., [24] showed a negative correlation in VO₂ max and body fat percentage. Similar results were shown by Davis et al., [25] and Huttunen et al., [26].

Historically, VO₂ max has been adjusted using ratio scaling that makes the assumption that once VO₂ max has been divided by body weight; any difference in VO₂ max due to body weight is removed. This is due to negative correlation between body weight and VO₂ per unit of body weight [27,28]. This relationship gives a misleading impression that a heavier persons have a relatively lower oxygen uptake and hence low aerobic capacity [27]. In fact lighter persons were more likely to be placed in a low VO₂ max category [29].

Total body fatness and aerobic capacity are frequently used in association with each other and it is often implied that these parameters are strongly inter-related. Both body fatness and aerobic fitness have been shown to be risk factors for future health outcomes. But, it is unclear whether these effects are related to one another or are independent risk factors. It has been argued that aerobic fitness is the primary factor influencing future health outcome.

The dietary guidelines [30] indicate that adults should perform moderate activity for at least 30 min daily. In 2008 Physical activity guidelines [31] recommended 60 min or more physical activity daily. It should be muscle and bone strengthening physical activity to improve or maintain VO₂ max levels. Unfortunately, the trends in life style and reduction in physical activity definitely alarms us for future health of young adults.

LIMITATIONS

It was a pilot study with a less sample size. More number of samples definitely will clear the results.

CONCLUSION

Regular physical activity definitely shows a higher aerobic capacity which was concluded in our study. The athletic females showed a higher VO₂ max levels in our study. As regarding the co-relation between VO₂ max and body fat percentage; there was a negative correlation but not statistically significant.

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