



# TO ASSESS CARDIOVASCULAR AND RESPIRATORY FITNESS USING QUEEN'S COLLEGE STEP TEST AND OXYGEN SATURATION IN UNDERGRADUATE FEMALE PHYSIOTHERAPY STUDENTS

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**Abstract:** Cardio-respiratory fitness is defined as the body's ability in utilizing oxygen to produce energy during physical activity. The best way to measure cardio-respiratory fitness is to assess VO<sub>2</sub>max. The main aim of this study was to assess cardio-respiratory fitness using Queen's College Step Test and Oxygen Saturation in Undergraduate Female Physiotherapy Students. Queen's step test and oxygen saturation of total 158 physiotherapy students were studied. Data was analyzed using descriptive analysis. Reduced cardio-respiratory fitness in the form of VO<sub>2</sub>max was identified and they were encouraged for lifestyle modification along with adequate physical activity done regularly to improve their cardio-respiratory fitness.

**Index Terms – Cardio-respiratory fitness, oxygen saturation, VO<sub>2</sub>max.**

## INTRODUCTION

Physical fitness consists of five elements which includes aerobic capacity, muscular strength, muscular endurance, flexibility and body composition. <sup>[1]</sup> Aerobic fitness is defined as the amount of capacity to perform a physical work under different conditions where in the circulatory and respiratory systems function in harmony. <sup>[2]</sup>

The maximal oxygen consumption (VO<sub>2</sub>max) as a measure of aerobic capacity has years ago been regarded by the World Health Organization as the sole best measure of cardiorespiratory fitness and is mainly used as a forecaster of cardiovascular morbidity and mortality. <sup>[3,4]</sup> Maximal oxygen consumption (cardiac output x oxygen content of arterial blood) which represents the highest rate at which oxygen can be taken up and absorbed by the cells during strenuous exercise. <sup>[5,6]</sup> The fundamental unit of evaluating the maximal oxygen consumption (VO<sub>2</sub>max) is its absolute value in terms of liters or millers per min. However, body weight exerts influence on the absolute value and is often expressed in terms of ml/kg/min. <sup>[7]</sup> The absolute value of VO<sub>2</sub>max is one of the best marker of an individual's aerobic capacity to carry oxygen to working muscles. <sup>[8]</sup>

The VO<sub>2</sub>max can be evaluated by maximal or submaximal tests using direct or indirect methods. <sup>[9]</sup> However, the apparatus is costly and unsuitable in yard and controlled test conditions and besides it requires a top level of practical expertise and management. <sup>[10]</sup> Hence, submaximal exercise tests are often used to predict the VO<sub>2</sub>max. Submaximal tests are differentiated as predictive or performance tests. Predictive submaximal tests may also be further classified into treadmill and field tests. <sup>[11]</sup>

One such field test is Queens College Step Test which is inexpensive and requires minimal use of equipment along with its simple and effective use. Step tests are one of the most extensively used field tests for evaluating VO<sub>2</sub>max as stepping requires no complex or costly apparatus and can be simply employed on a number of individuals. Majority of the employed steps tests are executed at a fixed cadence on a stepper of fixed height. One such test is Queen's College Step Test developed by McArdle et al and Molanouri Shamsi et al. <sup>[12]</sup> McArdle et al in 1972, determined the reliability and validity for a 3 minutes step test i.e. Queen's College Step Test for estimating VO<sub>2</sub>max in a number of college girls. <sup>[13]</sup> Also, the direct relationship between pulse rate and VO<sub>2</sub>max has been fruitfully administered in a number of fitness tests. <sup>[14]</sup>

During exercise, to a certain extent the increase in absorption of oxygen is directly proportional to the energy utilized and all the energy requirements are met by aerobic respiration. <sup>[15]</sup> Exercises in step tests can be used as an efficient aerobic exercise which on regular basis can enhance the cardiorespiratory endurance of a person. <sup>[16]</sup> Das and Bhattacharya (1995) have suggested that Queen's College Step Test would be highly fit for the younger individuals of both inactive and athletic background. <sup>[17]</sup>

## NEED FOR STUDY

In today's world, regular physical activity plays a very important role in forming one's healthy lifestyle.

In recent times reduction in physical activity among young adults has been seen and there is startling decline of physical fitness especially among college students. [18] Calculating the height and weight it was seen that approximately 35% of young adults are overweight or obese. [19]

Keeping these factors in mind the present study emphasizes on cardiovascular and respiratory fitness in undergraduate physiotherapy students by using Queen's College Step Test to predict the maximal oxygen uptake and Oxygen Saturation.

Hence, knowing about VO<sub>2</sub>max will help the students to analyze their cardiovascular and respiratory fitness.

## REVIEW OF LITERATURE

- A study on "Assessment of cardiovascular fitness [VO<sub>2</sub> max] among medical students by Queens College step test" (2015) by Tauseef Nabi, Madeena Rafiq and Ouber Qayoom reported that female students have lower levels of aerobic fitness compared with male students and improvements in cardio respiratory fitness have positive role effects on depression, anxiety, mood status and associated with a higher academic performance.
- A study on "Validity of Queen's College Step Test for estimation of maximum oxygen uptake in female students" (2005) by Satipati Chatterjee, Pratima Chatterjee & Amit Bandyopadhyay stated that modified equation is recommended for application of Queen's College Step Test as a valid method to evaluate cardiorespiratory fitness in terms of VO<sub>2</sub>max for large numbers of sedentary females university students of West Bengal, India.
- "A Study of VO<sub>2</sub> Max and Body Fat Percentage in Female Athletes" (Dec 2014) by Anjali N. Shete, Smita S. Bute, P.R. Deshmukh reported that athletic females showed higher VO<sub>2</sub>max levels and it should be muscle and bone strengthening activity to improve or maintain VO<sub>2</sub>max levels.
- A study on "Affect of Different Intensities of Queens College Step Tests on Cardiopulmonary Function and Body Composition in Students" (Dec 2019) by Seulgi-Choi, Sumi Sim, Minjin-Kim, Ji-Heon Hong, Dong-Yeop Lee, Jae-Ho Yu, Jin-Seop Kim reported that altering Queen's College Step Test into various exercise programs by modifying intervals with High Intensity Interval Training can provide significant improvements in cardio respiratory endurance and body composition.
- A study on "Cardio respiratory fitness of boys (2005) by Satipati Chatterjee, Pratima Chatterjee and Amit Bandyopadhyay reported reduction in overall VO<sub>2</sub>max due to grossly reduced oxygen utilization by adipose tissue during exercise.

## AIM

To assess cardiovascular and respiratory fitness using Queen's College Step Test and Oxygen Saturation in undergraduate female physiotherapy students.

## OBJECTIVES

To study the cardiovascular and respiratory fitness in undergraduate female physiotherapy students using Queen's College Step Test and Oxygen Saturation.

## METHODOLOGY

**Study Design** : Cross Sectional Survey Study

**Sampling Method** : Purposive Sampling

**Sample Size** : 158

**Study Setup** : Tilak Maharashtra Vidyapeeth's Lokmanya Tilak College of Physiotherapy, Kharghar, Navi Mumbai

**Inclusion Criteria** : 1] 18-25 years of age group

2] Females

3] Undergraduate physiotherapy students

**Exclusion Criteria** : 1] Below 18 and above 25 years of age group students

2] Male physiotherapy students

3] Diagnosed case of cardio respiratory, musculoskeletal and neurological disorders, diabetes mellitus, hypertension, etc.

**Materials** : Stepper (height: - 16.25 inches / 41.3 cm), stopwatch, calculator, metronome beats application, pulse oximeter.

**Outcome Measures** : 1] Queen's College Step Test calculating PVO<sub>2</sub>max (reliability: - 0.92; validity: - 0.75)

• Women =  $65.81 - (0.1847 * \text{pulse rate beats/min})$

2] Oxygen Saturation

## PROCEDURE

- Approval will be taken from the ethical committee of the institute.
- Information sheet and consent form will be given to the students and demographic details will be taken.
- The experimental protocol will be fully explained to the subjects who will be fulfilling the inclusion criteria based and consent of every single subject will be taken.
- Firstly, pre-test oxygen saturation and then immediate post-test oxygen saturation of the students will be recorded.
- The subject steps up and down on the platform of 16.25 inches at a rate of 22 steps per minute for females. The subjects are to step using a four-step cadence, 'up-up-down-down' for 3 minutes. The subject stops immediately on completion of the test, and the radial pulse will be counted 5 seconds after stopping, for a period of 15 seconds and multiplied by four to get the pulse rate/min.
- The following equation will be used to predict  $VO_2\text{max}$  indirectly by following Queen's College Step Test:
- For women:  $VO_2\text{max (ml/kg/min)} = 65.81 - (0.1847 * \text{pulse rate beats/min})$

## DATA ANALYSIS AND RESULT

Descriptive statistics was used to summarize the data collected in simple numerical form using MS Excel.

The data collected was statistically analyzed and presented in the form of pie charts.

Total of 158 responses were collected from physiotherapy students of 1st year, 2nd year, 3rd year, 4th year and interns.

**Figure 1**

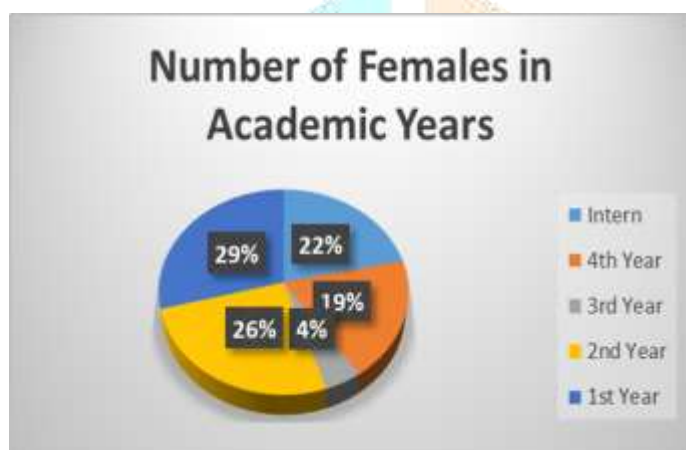


Figure No. 1 Illustrates the academic years of all physiotherapy students at Tilak Maharashtra Vidyapeeth's Lokmanya Tilak College of Physiotherapy that have participated in the study. Out of 158 participants, 22% were from the intern's batch, 19% were from the 4th year, 4% from the 3rd year, 26% from the 2nd year and 29% from the 1st year.

**Figure 2**

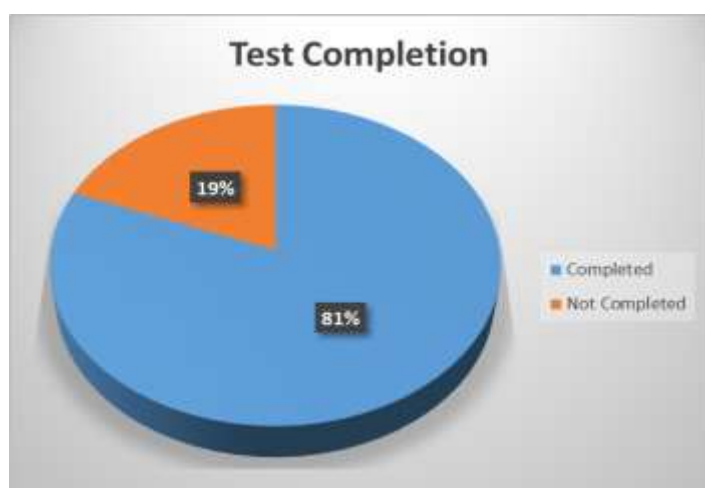


Figure No. 2 Illustrates that only 19% participants were unable to complete the test while 81% participants completed the test.

Figure 3



Figure No. 3 Illustrates that majority of the participants i.e. 63% stopped the test after one and half minutes while 37% stopped the before one and half minutes.

Figure 4

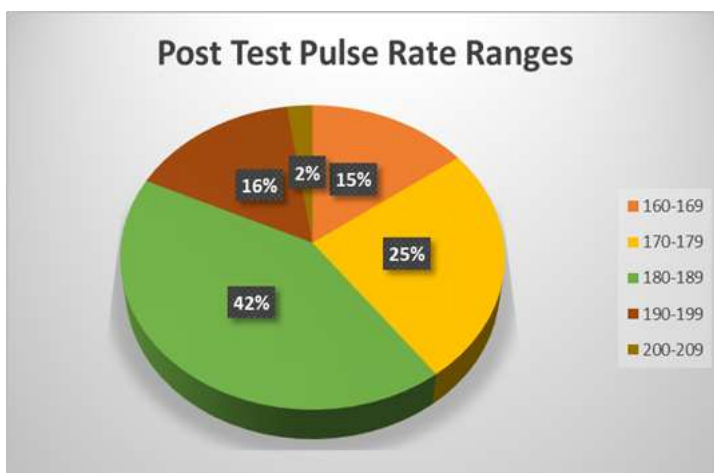


Figure No. 4 Illustrates that 15% had post-test pulse rate between 160-169 bpm, 25% had between 170-179 bpm, 42% had between 180-189 bpm, 16% had between 190-199 bpm and only 2% had between 200-209 bpm.

Figure 5



Figure No. 5 Illustrates the VO<sub>2</sub>max score of the participants. 52% participants had below average VO<sub>2</sub>max score while 48% had poor score of VO<sub>2</sub>max.

## DISCUSSION

The study is done to assess the cardiorespiratory endurance and oxygen saturation in undergraduate female physiotherapy students using Queen's College Step Test.

According to the results of the study the cardiorespiratory endurance in the form of  $VO_2$ Max of all the students is below average and poor which depicts that the cardiorespiratory endurance of all the students is affected.

Since 9 students had positive medical and surgical history, they were not included in the study. It was found that 19% of the population included in the study did not complete the test because of overweight and obesity. It was observed that 37% of the population stopped the test before 1:30 minutes due to not in sync with metronome used in the test; while remaining of them stopped the test after 1:30 minutes because of breathlessness and fatigue.

It was seen that there was no remarkable change in the oxygen saturation before and after the test.

Majority of students had reduced cardiorespiratory endurance and the reason can be reduced physical activity, sedentary lifestyle, unhealthy eating behaviours leading to obesity and further decline in physical fitness <sup>[20]</sup>

In order to improve  $VO_2$ max levels, daily physical activity focusing on muscle and bone strengthening should be incorporated for 60 minutes. <sup>[21]</sup>

## CLINICAL IMPLICATIONS

Students can be made aware of the risk factors related to cardiovascular and respiratory system and how it can have negative influence on their functional capacity.

Further students can be encouraged to engage themselves into healthy lifestyle.

## FUTURE SCOPE OF STUDY

- Borg rating of perceived exertion scale can be used pre-test and post-test to make the study more sensitive.
- Further studies can be continued with varied sample size, population and setup so that reliability of the results can be further established.

## CONCLUSION

The study concludes that all female physiotherapy students have decreased  $VO_2$ max scores in poor and below average group. However, the oxygen saturation was in the normal range in all the female students.

## LIMITATIONS

- All the participants were physiotherapy students from one institute with sample size of 158 students with specific age group of 18-25 years and includes only female students as well do not represent the total student population, therefore results cannot be generalized to other student population.

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