

## **Investigation of aerobic capacity in first year medical students**

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### **Abstract**

**Objective:** Measurement of cardiorespiratory fitness in young medical students can be more than just a checkup, carrying educational and motivational values and attitude forming. Aerobic capacity ( $VO_2max$ ) is believed to be most reliable parameter of physical fitness and cardiorespiratory health.

**Method:**  $VO_2max$  was evaluated in the students employing submaximal exercise one stage step test, in age matched boys and girls students of first year MBBS enrolling from nationwide domains. 20 each males and females of 18-19 year age were selected with due criteria to take Queens College step test, after converscence.  $VO_2max$  estimation was indirect from post exercise recovery heart rate.

**Results:** Boys exhibited higher aerobic capacity than girls. The body mass indices (BMI) of boys and girls do not differ but higher BMIs associated with insignificant yet consistently lower aerobic capacities. Estimated  $VO_2max$  in studied sample of medical students finds rating just as "fair" in prevalent standards.

**Conclusion:** The findings in entrant medical students drawn from nationwide residences emphasize the need for administration of regular exercise programmes in the medical student community toward improved cardio respiratory fitness, better performance and quality of life.

**Keywords:**  $VO_2max$ ; aerobic capacity; physical fitness; cardiorespiratory fitness.

### **1. Introduction**

Fitness of individuals is conventionally assessed as aerobic capacity, muscle power and resistance to fatigue, flexibility and body composition. As per contemporary view, the maximum amount of oxygen a person is capable of consuming upon muscle exercise, called  $VO_2max$ , is most reliable indicator of cardio respirator fitness [1].  $VO_2max$  indicates aerobic capacity and fitness [2]. Tests involving maximal or submaximal graded exercises, such as walking, running, cycling or stepping are employed to assess the  $VO_2max$ [3]. Either direct measurement or indirect calculations are used strategically to asses  $VO_2max$  and step tests are particularly suited for field use [4]. In the step tests, subjects step up and down for 3 to 5 minutes on bench of specific height at specific step rate per minute. Consequent post exercise heart rate during recovery is used to estimate cardiorespiratory fitness in terms of  $VO_2max$ , by formula based on regression modeling of relevant independent and dependant bodily variables. Conventional single stage Queens college step test reported by McArdley et al in 1972[5] considers variables as recovery heart rate, test duration, age, gender, body weight in the regression model to predict  $VO_2max$ . The basic premise of submaximal exercise tests is

that linear relationship exists between heart rate and oxygen consumption[5-7].

### **2. Subjects and method**

Study sample was derived from first year MBBS students of 2014 admission batch at All India Institute of Medical Sciences, Bhopal, MP. The students were drawn from all over the country. Students were informed about the study intention and test procedure for assessment of their aerobic capacity as index of cardiorespiratory fitness. Each one was included after written consent to participate in study that was permitted by the authority. Volunteers from among 100 strong batch were given exposure to the test for converscence. They were shown four steps up/up and down/down process for two legs, keeping knee and back straight. Metronome was used to help maintain required step rate per minute. Heart rate of those able to complete 3 minute test as desired were noted just after the test. Those who attained heart rate close to ( $\pm 10$ ) their predictable maximal heart rate as per formula of Tanaka et al[8], were excluded. Finally, 20 boys and 20 girls within 18 to 19 year age were selected. These were included on satisfying criteria viz. no

history of any illness or medication over past one month; not consuming cigarettes or alcohol, not devoting to any regular exercise programme. Girls were tested on a day preceding or succeeding the menstrual period.

Height and weight were measured to calculate the body mass index (BMI), using formula:

$$\text{BMI} = \text{body weight in Kg} / (\text{height in Meters})^2$$

As per the national gradation normal BMI is between 18.5 and 22.9, below this are underweight. Those with BMI between 23 and 24.9 are labeled over weight and persons with BMI 25 and above are obese.

**2.1 Step Test:**

The students were instructed to

- i) Wear comfortable loose clothes and shoes appropriate for the stepping exercise test;
- ii. Drink plenty of fluids in preceding 24 hours for good hydration;
- iii. Take light breakfast of liquid or thin semisolid food and no tea or coffee before 3 hours of the test;
- iv. Avoid any strenuous physical activity in preceding 48 hours.

Test was carried out during months of October-November 2014 at morning room temperature between 9am to 10 am. The same room was venue of the test which was quiet, and had a comfortable bed, armed chair and the stepping tool. After relaxing the subject for 10 minutes in bed, heart rate, respiratory rate and supine blood pressure were recorded. (Average of two recordings 2 minutes apart).

Step test was conducted on a wooden tool 16.25 inches height. (The stepping tool height is kept to suit subjects of average height and give hip angle of 73.3 degrees adapted as per Francis & Culpepper equation [9] The student were instructed to step upon the same 24 times (boys) or 22 times (girls) per minute for three minutes without break. (They had accustomed themselves to such rate by earlier practice before one week)

Upon finishing the exercise students were immediately seated in the armed chair and their carotid pulse was counted for earliest possible 15 seconds (from 5<sup>th</sup> to 20<sup>th</sup> second of finishing exercise). This count was then quadrupled to get heart rate per minute. VO<sub>2</sub>max was estimated by following formulae [5]:

For males: VO<sub>2</sub>max ml/kg/min= 111.33-[0.42xpulse rate beats/min]

For females: VO<sub>2</sub>max ml/kg/min =65.81-[0.1847xpulse rate beats/min]

**3. Observations and result**

**Table 1: Distribution of the students in various BMI categories was as under:**

BMI Category	Boys (n)	Girls (n)
Obese	7	5
Overweight	5	6
Normal weight	7	7
Underweight	1	2

By rounding off individual BMIs to nearest whole figure the median BMI in boys was 24 and in girls 23. Net mean BMI in boys was 24.4+6.6 and girls 23.6+7.1. There was no significant difference in BMI compositions in male and female groups therefore.

**Table 2: Mean values of calculated VO<sub>2</sub>max (ml/kg/min) for the obese versus nonobese (combined) were as under**

Gender	Non obese	Obese
All 40	42.6±8.1(n=28)	40.8±9.2(n=12)
Males	46.7±9.7(n=13)	45.1±10.2(n=7)
Females	37.9±10.4(n=15)	37.1±8.7 (n=5)

It is obvious that boys exhibited higher aerobic capacities (VO<sub>2</sub>max) than the girls, although due to small sample results are not statistically significant on absolute values and t test statistic. The same difference becomes significant on Moods median test statistic. Another aspect is insignificant but consistently lower VO<sub>2</sub>max in obese male or females than nonobese counterparts.

**4. Discussion**

VO<sub>2</sub>max assessment provides insight to systemic efficacy of oxygen delivery and consumption. VO<sub>2</sub>max is also reliable indicator of maximal exercise capacity [10]. It is product of maximum cardiac output and maximal difference of arteriovenous oxygen concentration [11]. Direct VO<sub>2</sub>max measurement by maximal exercise testing and with complex metabolic cart is non-feasible for use as field test. Submaximal exercise tests with indirect prediction of cardiorespiratory fitness are therefore developed. VO<sub>2</sub>max is the highest VO<sub>2</sub> measured over any 30 seconds and is presented as ml/kg/min. Validity of indirect prediction of VO<sub>2</sub>max from step test may be affected by use of same stepping tool and rate for subjects of different stature. Study by Shamsi et al[12] however did not find height of subjects to influence the VO<sub>2</sub>max calculation in Queens college step test. Adjustment of height of stepping tool for individuals of varied stature was found unnecessary also by in an earlier study [13].

The VO<sub>2</sub>max values calculated in the study, i.e. boys (all) 45.3±9.9 and girls (all) 37.4±9.7 are wide apart with males exhibiting higher VO<sub>2</sub>max. Obesity clearly shows association to lower VO<sub>2</sub>max values although small, because these entry level students are in prime of youth. When referred to standard VO<sub>2</sub>max grading [14], the whole range of VO<sub>2</sub>max found in study subjects falls merely in “fair” category of cardiorespiratory fitness. This is most likely reflection of suboptimal lifestyle and poor exercise in daily routine of these average medical students. Such state is obviously not compatible with challenging professional strains. Studies have indicated successful uplift of VO<sub>2</sub>max by regular moderate to heavy exercise both in obese and nonobese people [15]. Even the present mood, quality of life and academic performance should be better with adoption of regular exercise, as stated in the adage, “Healthy mind in healthy body”. Knowledge of cardiorespiratory fitness from

such baseline assessments can be educational, motivational and useful for identifying progress and strife to improvement.

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