

Cardiorespiratory Fitness among MBBS Students of RIMS, Imphal

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Abstract:

Background: Cardio respiratory fitness is the ability of the cardiovascular and respiratory system to supply oxygen to the working muscle tissues and the ability of the muscles to utilize oxygen to produce energy. Maximal Oxygen uptake ($VO_2\text{max}$) is the Gold standard to measure the cardio respiratory fitness. High fitness level lowers the risk of many health problems like cardiovascular diseases, Diabetes, Obesity etc. Hence it is required for students to measure and analyze their fitness for a healthy lifestyle.

Objective: To determine the cardio respiratory fitness of MBBS students

Materials and Methods: In this cross sectional study, 55 healthy volunteers (age 20-29 yrs) were recruited from among the MBBS students of RIMS, Imphal. Cardio respiratory fitness in terms of $VO_2\text{max}$ was assessed by the Bruce Protocol treadmill test.

Results: The mean $VO_2\text{ max}$ was $41.3471 \pm 6.80 \text{ ml/kg/min}$. It was found that the mean $VO_2\text{max}$ of the students who exercise regularly ($n=28; 45.74 \pm 4.8 \text{ ml/kg/min}$) was significantly higher than students who don't ($n=27; 36.08 \pm 4.7 \text{ ml/kg/min}$) [$p=.000$]. Also, the $VO_2\text{ max}$ of males ($n=35; 42.80 \pm 6.8 \text{ ml/kg/min}$) was higher than females ($n=20; 38.79 \pm 6.0 \text{ ml/kg/min}$) [$p=.029$]. Categorizing them in the fitness scale, exercising students fall on and above the 'good' level and most of the students who don't exercise fall on and below the 'Fair' level.

Conclusion: The study shows that students who regularly exercise have a better cardiorespiratory fitness. This shows that regular exercise is important to achieve a healthier cardiorespiratory fitness as well as overall health.

Keywords: Cardiorespiratory fitness, $VO_2\text{max}$, Exercise

I. Introduction

Cardiorespiratory fitness is the ability of the cardiovascular and respiratory system to supply oxygen to the working muscle tissues and the ability of the muscles to utilize oxygen to produce energy during continuous physical activity [1]. Maximal Oxygen uptake ($VO_2\text{Max}$) is the Gold standard to measure the cardio respiratory fitness. It is the maximum amount of oxygen that one can utilize during intense or maximal exercise. Typically, $VO_2\text{max}$ is measured by analyzing breathing gases in a laboratory setting during maximal exertion. However, because the test requires expensive equipments with a difficult and exhausting experimental protocol, they are not feasible for large scale use. Hence a variety of indirect methods like maximal or sub maximal exercise protocols are used. [2, 3]

A high fitness level has been associated with a reduced risk of cardiovascular diseases (CVD), Obesity, Diabetes, Cancers and mental health problems. Cardiorespiratory fitness is also recognized to be a stronger predictor of mortality than established risk factors such as hypertension, smoking, and diabetes in both healthy individuals and those with CVD. Lifestyle factors, especially physical activity, are important modifiable determinants of fitness [1, 4, 5, 6]. The present study aims to find out the cardiorespiratory fitness of the MBBS students of RIMS, Imphal. Measuring and analyzing the fitness level of the students is required so that they can improve their fitness and maintain a healthy lifestyle.

II. Materials and Methods

After approval from the Institutional Ethics Committee, this cross sectional study was conducted in Physiology department, RIMS, Imphal from May 2015 to January 2016. 55 healthy volunteers (age 20-29 yrs) were recruited from among the MBBS students of RIMS, Imphal. Those with history of any acute or chronic illness or undergoing any kind of medication were excluded from the study.

The purpose of the study and procedure of the experiment were explained to the subjects and informed consent was taken. The subjects were instructed not to have any heavy meal nor take any coffee or tea at least 2

hours before the test. Firstly, a detailed history was taken including physical activity and other lifestyle habits for comparison purposes. Those who do at least 150 minutes of any type of moderate aerobic activity (like brisk walking, cycling etc) , were considered to be exercising students (Global recommendations on Physical Activity for Health By World Health Organization, 2010) . A general physical examination was also done. Basal Pulse rate and Blood pressure were taken. The height and weight were measured and Body Mass Index was calculated using the Quetelet index formula: Height (meter²)/weight (kgs).

Cardiorespiratory fitness in terms of VO₂ max was assessed by the Bruce protocol treadmill test [7]. The subjects were instructed to run in the treadmill starting with a warm up at a speed of 2.7 km/hour and gradient of 0 for about 3-4 minutes after which the speed and gradient will increase every 3 minutes as given in Table 1. The students were asked to run till they reach volitional exhaustion. In case of any chest pain, cramps or giddiness they were asked to stop the exercise immediately. The VO₂ max, was estimated using the Bruce Protocol formula:

For Males = $14.8 - (1.379 \times T) + (0.451 \times T^2) - (0.012 \times T^3)$; For Females = $4.38 \times T - 3.9$ where T is the total time taken to run on the treadmill. VO₂ max is expressed in ml/kg/min. Pulse rate was measured immediately after exercise and 2 minutes after exercise to check for the recovery rate, which was calculated by subtracting the pulse rate at 2 minutes post-exercise from the pulse rate at immediate post exercise. The recovery of heart rate can give an idea regarding the fitness of an individual. The faster the heart rate recovers towards the basal rate, the fitter the individual.[8,9] Data was analyzed using SPSS version 21 and independent t-test was used for inferential statistics . P value of <0.05 was considered statistically significant.

Table 1 : Bruce Protocol

Stage	Minutes	% grade	km/h	MPH	METS
1	3	10	2.7	1.7	5
2	6	12	4.0	2.5	7
3	9	14	5.4	3.4	10
4	12	16	6.7	4.2	13
5	15	18	8.0	5.0	15
6	18	20	8.8	5.5	18
7	21	22	9.6	6.0	20

III. Results

Out of 55 subjects, 35 were males and 20 were females. All subjects are non vegetarian, one subject reported smoking, 28 were exercising students . The basal parameters are given in table 2. The mean systolic and diastolic blood pressures of the students were 119.89 ± 7.35 and 77.53 ± 6.76 mmHg respectively . The mean basal pulse rates , immediately after exercise and 2 mins after exercise were 77 ± 4.8 beats /min, 138 ± 7.77 beats/min and 105.35 ± 7.34 beats/min respectively. Mean BMI was 21.35 ± 1.59 kg/m² . Mean recovery rate of pulse was 34.25 ± 9.16 . All the subjects have a normal basal pulse rate and blood pressure. BMI of all the students were in the “Normal” category (The NIH and Asian Adaptations of the WHO criteria for overweight and obesity).

The mean VO₂ max was 41.3471 ± 6.80 ml/kg/min. It was found that the VO₂ max of the students who exercise regularly (n=28; 45.74 ± 4.8 ml/kg/min) was significantly higher than students that don't (n=27; 36.08 ± 4.7 ml/kg/min) [p=.000]. Also, the mean VO₂ max of males (n=35; 42.80 ± 6.8 ml/kg/min) was significantly higher than females (n=20; 38.79 ± 6.0 ml/kg/min) [p=.029].The recovery rate of pulse was also found to be significantly higher in subjects who exercise (42 ± 5.37) than those who don't (29.22 ± 3.58) [p=.000].

Categorizing them in the fitness scale (table 3(i) and (ii))[10], students who exercise fall on and above the ‘good’ level and most of the students who don’t exercise fall on and below the ‘Fair’ level (Fig.1). There was no significant association of VO₂ max with age, BMI, Blood Pressure and Pulse rate.

Table 2: Basal parameters , post exercise pulse rate and recovery rate

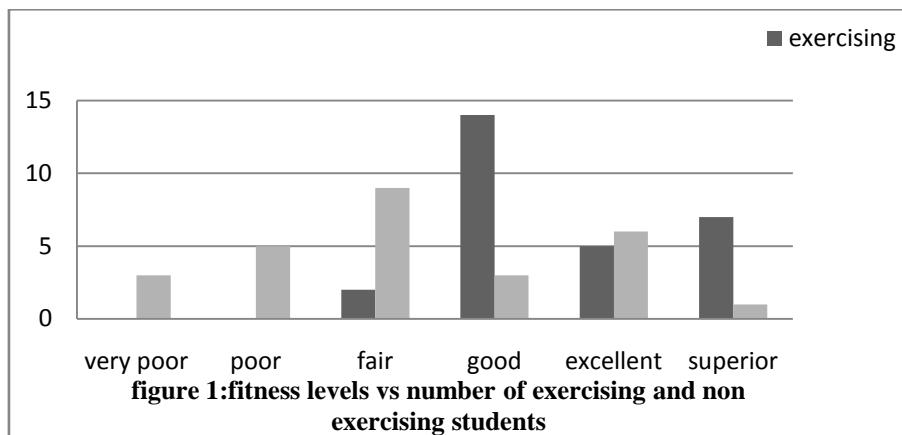
Parameter	Mean	S.D
Systolic BP (mmHg)	119.89	7.35
Diastolic BP(mmHg)	77.53	6.76
Basal Pulse rate (PR) (beats/min)	77	4.8
PR immediately after exercise(i) (beats /min)	138	7.77
PR 2 mins after exercise(ii)(beats/min)	105.35	7.34
Recovery rate(i-ii)	34.25	9.16

Table 3 (i): Normative data for VO₂max in Females (ml/kg/min)

Age	Very poor	Poor	Fair	Good	Excellent	Superior
20-29	<23.6	23.6-28.9	29-32.9	33.0-36.9	37.0-41.0	>41.0

Table 3 (ii): Males (ml/kg/min)

Age	Very Poor	Poor	Fair	Good	Excellent	Superior
20-29	<33.0	<33.0-36.4	36.5-42.4	42.5-46.4	46.5-52.4	>52.4



IV. Discussion

Data from the present study showed that students who exercise regularly have a higher $\text{VO}_2 \text{ max}$ value and when we categorize them in the fitness scale, these students have a better fitness level compared to the students who don't. Also, the post exercise heart rate of the exercising students takes lesser time to recover which further shows their superiority in the fitness level.

The World Health Organization (WHO) and the American Heart Association (AHA) have recommended at least 150 minutes of moderate-intensity aerobic physical activity (e.g brisk walking, cycling, recreational badminton, etc) in a week or do at least 75 minutes of vigorous-intensity aerobic physical activity (e.g jogging, basketball game, hiking, etc) in a week or an equivalent combination of moderate- and vigorous-intensity activity, in order to improve cardiorespiratory and muscular fitness, bone health, overall cardiovascular health and depression. So, it is encouraged that the students should start doing an adequate amount of physical activity per week and for those who are already exercising, to continue so that they can achieve and maintain a healthier cardiorespiratory fitness level as well as overall health.

The study also showed that males have a higher $\text{VO}_2 \text{ max}$ value than females but this difference is due to the inherent biological differences like testosterone and estrogen levels, muscle mass, Hemoglobin levels, etc disregarding their physical activity levels [2]. As shown in table 3 (i) and (ii), there is a separate fitness scale for males and females and when the subjects are categorized into the fitness levels both the genders fall into similar categories depending on whether they exercise or not.

There are some limitations to this study. First, the sample size was small. Secondly, all students were in the "normal" category of BMI as well as having similar dietary habits, so it is recommended for studies to be done with a larger sample size and with different BMI categories and dietary habits for better comparisons.

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