

Assessment of Cardio-pulmonary Efficiency in Medical Students- A Cross Sectional Study

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Abstract

Cardio-respiratory fitness is an important element of health that requires a combination of the various systems as circulatory, respiratory, and muscular systems to supply oxygen to the working tissues during physical activity. It is important for the performance of functional activities and quality of life.

Aims and Objectives: The purpose of this study was to assess the cardiovascular fitness level of medical students.

Materials and methods: A total of 200 healthy students of both sexes volunteered for this study and were subjected to submaximal exercise testing and their pre- and post-exercise heart rate readings were noted. YMCA 3-min step test, a submaximal test based on how quickly our heart rate recovers following a short bout of exercise, was used to determine the cardio-respiratory fitness.

Results: 4% of students had excellent while 7% had good cardiorespiratory fitness. 18% scored above average, 39% average while 28% scored below average fitness score. 4% students were having poor cardio-respiratory fitness and none of the students showed very poor score.

Conclusions: It was concluded in our study that very few students were found to have good cardio-respiratory fitness status. Majority of students were having only average, below average and poor cardiorespiratory fitness score. This indicates that medical students are not aware of importance of their health which may be due to their lengthy curriculum, long study hours, stress of their studies that is putting a lot of strain on their physical and mental health. They should be made aware of importance of preserving fitness by recommending regular physical activity.

Introduction

Medical students exercise with less frequency, do not maintain a nutritious balanced diet and are subjected to stress, largely due to heavy academic work load. Due to these, it becomes difficult for these students to maintain a regular exercise program leading to deterioration of nearly all aspects of health. Physical and mental fitness are the key to a positive outcome. Physical fitness includes: General fitness that is a state of health and well-being and Specific fitness that is the ability to perform specific sports or professions (1). Physical fitness depends on several factors like heredity, environment, regular exercise, balanced and

nutritious diet, and also adequate rest for recovery (2). Physical fitness is a powerful health index and cardiorespiratory fitness is the most pertinent health related component of physical fitness that can contribute in the prevention of chronic diseases, thus providing us with better health and quality of life. Physical Activity can be defined as any body movement produced by skeletal muscles where energy is produced. In recent years, it has been observed that there is a decrease in physical activity due to a more sedentary lifestyle. Inadequate physical activity accounts for approximately 30% of all deaths, mainly due to heart disease, diabetes and colon cancer (3). Being physically active and leading a

dynamic lifestyle could significantly reduce mortality from these events. Even with smaller increase in physical activity, mortality from chronic conditions combined could be reduced by 5-6% annually(4). Regular physical exercise is known to have beneficial effects in the untrained person and in persons having chronic ailments like Diabetes, Obesity & Hypertension. Physical fitness is extremely important to maintain good health throughout the life of the individual and also to increase longevity of the individual. This has become more critical in the modern world where mechanizationalong with a sedentary life style and western diet has considerably reduced the good health of individualsof all ages as reflected by increasing incidence of chronic diseases like obesity, cardiovascular diseases, diabetes mellitus and cancers(5). Physical Activity is behavioural aspect and can be described as any bodily movement that is produced by skeletal muscles where energy is produced and is different from cardiorespiratory fitness which is a trait and is ability of circulatory, respiratory, and muscular systems to supply oxygen during prolonged moderate-to-severe dynamic physical activity (6). Cardiorespiratory fitness is usually measured using treadmill or ergometer exercise tests and is often expressed as maximal oxygen consumption (VO₂max). To accurately determine VO₂max, Maximal exercise tests on a treadmill or cycle ergometer are performed till exhaustion and then measured by indirect calorimetry. Maximal exercise tests for measurement of VO₂max are costly, time-consuming, require a high level of technical experience, supervision and motivation to get exhausted under high-intensity load, difficult for individuals who do not have an exercise habit, are elderly, or those having diseases (7). On the other hand, Submaximal tests are those with exercise intensity below 85% of age-predicted maximum heart rate. Submaximal exercise refers to non-exhaustive exercises that disturb homeostasis by increasing the metabolic rate. Submaximal tests to predict cardiorespiratory fitness are safe, reliable and easy to perform as compared to maximal tests (8). Submaximal tests are performed by running, cycling, treadmill, cycling on ergometer, stepping up and down a bench. One such test to assess cardiorespiratory fitness is YMCA (Young Men's Christian Association) 3-minute step test that is valid, reliable, feasible, safe and low in cost (7). Lot of emphasis has been laid on assessing cardio-respiratory efficiency to determine the physical fitness. If properly assessed, it is exceedingly valuable health and life expectancy

indicator. It is important to get the maximum number of people into moderate amount of regular activity. So, it becomes important to determine the ability of the population to carry out physical activity. It will be the best to recruit young people for assessment of cardio-respiratory fitness as this would allow more interventions in this age group and in the long run will lead to greater reductions in morbidities and mortalities(6). Many studies have already been done in young population to assess cardio-respiratory efficiency but only few in medical students. Therefore, young medical students were thought to be a better group to evaluate cardio-respiratory fitness in them so that suitable strategies can be planned if necessary. Although recently, National Medical Commission has recommended regular physical activity in medical curriculum, even then the practice of physical activity is low amongst the medical students. This study will allow the medical students to develop maximum physical potential in addition to improving their physical and mental health and also diminishing the deleterious consequences of sedentary life style.

Material and Methods

The present cross-sectional study was conducted in the Department of Physiology, Guru Gobind Singh Medical College and Hospital, Faridkot after obtaining ethical permission from Institutional Ethical Committee. A total number of 200 medical students of both sexes in the age group of 18 to 25 years were included in the study. Informed consent was taken from each participant. Students suffering from any medical illness like cardiopulmonary disorders, endocrine disorders, and chronic diseases as neurophysiological disorder, musculoskeletal disorder, any other known medical/systemic condition or on any regular medication were excluded from the study. Their anthropometric variables such as height and weight each student was measured and Body mass index (BMI) was calculated in Kg/m². Their baseline heart rate and blood pressure were measured in the supine position. Cardiovascular Fitness was calculated by measuring heart rate after performing YMCA 3-minute step test. Subjects were instructed to take their last meal at least two hours before conducting the test in order to avoid the specific dynamic action (SDA) of food. The procedure was carried out at ambient temperature of 20° -25°C. All the subjects were made to rest for 5 minutes just before the procedure to get accurate results and procedure was explained to them properly. YMCA 3-

minute bench step test is based on the heart rate recovery following 3 minutes of exercise on 12-inch-high bench. Online Metronome was used. Stepping frequency of metronome was set at 96 beats per minute (4 clicks = one step cycle) for a stepping rate of 24 steps per minute. The subjects were instructed to exercise for 3 minutes by stepping on and off the step as 'up, up, down, down'. Immediately at the end of this protocol, the subjects were asked to sit down. After 5 seconds, their heart rate was counted for full one minute. Finally, subjects were allowed to rest for 5 minutes. Their heart rate score was located on the rating scale as given below.

Statistical Analysis: The data was compiled, tabulated and expressed as percentages. The calculated data was analyzed statistically.

Results

In this study, the mean age of male and female students was 21.85 ± 2.41 years. Table 1 shows demographic characteristics of the study population. Table 2 shows Cardio-Respiratory fitness of subjects by YMCA 3-minute step test as per scale in terms of percentage of students. Table 3 shows the Mean \pm Standard Deviation (Mean \pm S.D) in heart rate of subjects before test and immediately after the test. Results show highly significant change in heart rate after the test.

Rating for 18-25 year old individuals, based on Heart Rate (Beats/min)

Cardio-respiratory Fitness Rating	Females (bpm)	Males (bpm)
Excellent	52-81	50-76
Good	85-93	79-84
Above Average	96-102	88-93
Average	104-110	95-100
Below Average	113-120	102-107
Poor	122-131	111-119
Very Poor	135-169	124-157

Table 1: Demographic Characteristics of Study Population

Character	Male Students (n=100)	Female students (n=100)
Body Mass Index (BMI) Kg/m ²	22.40 ± 2.87	21.32 ± 3.02
Baseline Heart Rate (bpm)	77.65 ± 7.24	76.32 ± 7.31
Systolic Blood Pressure (mm Hg)	123.51 ± 12.04	121.19 ± 11.29
Diastolic Blood Pressure (mm Hg)	82.32 ± 11.12	81.54 ± 10.28

Table 2: Cardio-Respiratory Fitness by YMCA 3-minute Step Test

Grading	Male Students (Percentage %) (n= 100)	Female Students (Percentage %) (n= 100)	Total (Percentage%) (n=200)
Excellent	5	3	4
Good	9	5	7
Above Average	19	17	18
Average	40	38	39
Below Average	24	32	28
Poor	3	5	4
Very Poor	0	0	0

Table 3: Mean Heart Rate (Mean \pm S.D) Before and After YMCA 3-minute Step Test

Students	Baseline Heart Rate (bpm) Pre-test values (Mean ± S.D)	Heart Rate after YMCA 3- minute step test (bpm) Post-test values (Mean±S.D)	*p-Value
Male Students (n= 100)	77.65 ± 7.24	98.16±10.42	<0.0001
Female Students (n= 100)	76.32 ± 7.31	97.39±8.62	<0.0001

*p-Value <0.0001= Highly Significant

Discussion

Cardiorespiratory fitness describes the capacity of the cardiovascular and respiratory systems to provide muscles with oxygen during prolonged and moderate to severe exercise. It is one of the important components of health-related fitness. The aim of the study was to assess the cardio-respiratory fitness level on the basis of YMCA 3-minute step test which is a sub-maximal exercise test and 1-minute post exercise recovery heart rate following 3 minutes of exercise. It was observed in this study that only 4% of students had excellent fitness level and 7% had good cardiorespiratory fitness. 18% scored above average, 39% average while 28% scored below average fitness score. 4% students were of poor fitness while none of the students had very poor fitness score. It was apparent from the study that very few students were found to be fit as far as their cardio-respiratory fitness is concerned. Large number of students were found to be having average, below average and poor cardiorespiratory fitness score. Our findings are consistent with findings of other studies (9,10). Poor fitness score is definitely a crucial problem being a strong and an independent predictor of mortality in all the body mass index groups even after adjusting for other factors that increase mortality. Low cardio-respiratory fitness level of an individual is associated with higher mortality rate. Cardio-respiratory fitness reduces the risk of cardiovascular diseases and other diseases like hypertension, type 2 Diabetes, obesity, atrial fibrillation, chronic kidney disease, inflammation, heart failure, myocardial infarction, stroke and death (11). Cardio-respiratory fitness depends on many components, some of them are non-modifiable factors as genetics, age, sex, ethnicity (12). In a systematic review including many studies, it was concluded that Cardiorespiratory fitness decreases with age, is lower among women than among men, and is associated with ethnicity (13). Cardiorespiratory fitness also depends upon modifiable factors as smoking, alcohol consumption, educational status, nutrition, physical activity and

obesity (12). Cardiorespiratory fitness was found to be negatively associated with body weight, Body Mass Index, smoking and blood pressure, while was positively associated with several measures of Physical activity (13). Individuals with greater physical activity were found to have less decline in cardiorespiratory fitness per decade than do sedentary individuals and it was also observed that cardiorespiratory fitness improved with proper exercise participation (14). It was concluded in another study that the more physically fit an individual becomes the higher is their ability to deliver oxygen to the working muscles. Their exercise heart rate is lower and their heart rate will also recover faster from the exercise hence have better level of cardiorespiratory fitness (14). Hence, Physical activity and regular exercise is necessary to maintain normal body mass index and good cardio-respiratory health. It was concluded in a study that students who had more physical activity were having better cardiovascular fitness (15). The foremost reason for the medical students to have below average and poor fitness level in this study may be that they are negligibly involved in physical activity. Medical students are found to be more dedicated towards their education. The major reason is that they have a lengthy curriculum. They also fail to understand the importance of physical fitness in their life and in their academic achievements. Most of the students consider that involving in physical activity at young age is a waste of time (16). Medical students at our medical college are also engrossed in improving their knowledge and skills more than getting involved in physical activity. Being physically fit empowers us to meet the physical demands of everyday life even under stressful conditions. It has been recommended that basic cognitive functions as attention and memory that facilitate learning, are enhanced by physical activity and higher aerobic fitness. In one study, it was concluded that increased physical activity and hence physical fitness may improve academic performance (16,17). With the advancement of technology and modernisation, physical activity and manual work of people has significantly

decreased. This has led to physical inactivity, sedentary lifestyle and hence obesity. Physical inactivity is major risk factor for major non-communicable diseases as coronary heart disease, diabetes mellitus, cancers and hence also shortens life expectancy(11). Modification of risk factors including physical activity and regular exercise with balanced and nutritional diet can lead to improvement of life-threatening conditions. The awareness regarding the benefits of physical activity in improving cardio-respiratory fitness is important especially among those individuals who lead an inactive and sedentary lifestyle.

Conclusion

There is urgent need to encourage medical students to get engaged in physical activity and also to teach them the importance of inculcating physical activity in their lives, so that as physicians of tomorrow, they are capable of advising their patients regarding healthy lifestyle practices. Hence it is suggested that some physical activity should be mandatory in the curriculum of medical education which would help them to maintain cardiorespiratory fitness and reduce the risk of cardiovascular morbidity and mortality in the long run of their career.

Various types of exercises ranging from walking to brisk walk and jogging, running, playing sports, dancing, swimming, aerobic exercises and resistance training are in trend these days. Physical activity and exercise along with yoga and meditation may lead to better physical and mental health which in turn decreases morbidity and mortality related to lifestyle diseases.

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