Research Article

Assessment of cardiorespiratory changes in response to short term physical exercise in medical students

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Abstract

The current study was conducted to evaluate the main health benefits of short term exercise by assessing the effects on cardiorespiratory and aerobic power. 58 asymptomatic healthy male medical students in the age group 18- 20 years were the subjects who served as its own control. Subjects were classified according to their BMI. Physical training was given by using bicycle ergograph. Prior to the introduction of physical training schedule the physical fitness level of study population was assessed by testing various parameters. Subjects were asked to exercise at maximal load, with age adjusted maximal heart rate. Physical activity rating scale and Vo_2 max was used to assess the physical fitness. Blood Pressure was measured by oscillometry. Pulse rate and respiratory rate were recorded 1 min after exercise and pulse was also recorded 1.30 mins after exercise. Also ECG was recorded by a 12 lead electrocardiograph machine for S-T seg depression during the entire session. Double product is computed by taking the product of heart rate and systolic blood pressure. The mean and Standard deviation was calculated for all observations and statistical significance using paired't' test, and Correlation coefficient was calculated. Study revealed that with training there was statistical significant decrease in heart rate after 15 days of exercise while the other parameters did not show any change. Pearson's correlation coefficient was determined to assess the relationship between VO_2 max and BMI.A significant positive correlation was found between the study population having normal BMI and post exercise Corrected Vo2 max. The study also revealed that double product showed a drastic fall after 15 days of exercise which is found to be statistically significant. None of the ECG recorded showed ST Segment depression > 2 mm from the 'J' Point. It could thus be concluded that the study tested the hypothesis that life style modification including dietary education and regular exercise can be effective in increasing the physical fitness level of the subjects.

Keywords: cardiorespiratory, physical exercise.

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INTRODUCTION

The era has begun where one tries to prevent the disease or wish to detect it at a very early stage. There is no question that, being physically active and attaining minimum level of fitness are essential ingredients to a healthy life. Exercise testing therefore has been a means of finding out the physical, capabilities and physiological responses of an individual, It was suggested[1,2] that several factors like heredity, environment, diet, socioeconomic status and training contributes to performance of an individual. Though sufficient information is not available on the extent of changes observed in different systems in untrained Indian subjects but the evidence heavily favors that population or individual with high levels of physical activity tend to have, a lower prevalence of asymptomatic coronary artery disease. Thus, an understanding of the adaptations that the cardiovascular system undergoes during chronic exercise programs and the effect of different types and intensities of such programs upon cardiovascular and respiratory system have been of considerable interest to the physiologist, clinicians, public health workers and sports professionals. It was concluded that exercise stress testing is a valuable tool for evaluating physical fitness and cardio respiratory status[3]. Physical fitness level of an individual depends on the amount of oxygen which can be transported by the body to working muscles to use that oxygen, hence aerobic capacity (VO_2 MAX) or maximum oxygen uptake capacity has been widely considered to be reliable and valid indicator of cardio respiratory fitness. The aerobic capacity (VO_2 max) is considered as the best measure of an individual's capability for doing physical work, In fact it is the amount of oxygen that one can consume maximally, while exerting the highest level of physical effort. It can serve as a reliable yardstick to judge as to whether an individual will be able to accomplish a task without any signs of

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fatigue. Fatigue has got an adverse effect on health and performance of the individuals. Decrement in work capacity, as well as agility and alertness leads to accident potentialities as studied by[4,5] The present study was therefore undertaken to investigate the Cardio respiratory responses among untrained male medical students analyzing their VO_2 max and discussing their correlation with their Body mass index.

MATERIAL AND METHOD

The present study was carried out in the department of Physiology, Gandhi Medical College, Bhopal during January 2010-March 2011. Fifty eight asymptomatic healthy male medical students aged 19.707±1.22 were included in the study to perform short term limited duration exercise on bicycle ergograph. Each subject served as its own control. Only those students were included in the study who were not having any known respiratory, neuromuscular, cardiac or endocrine disorder. And the subjects who were doing regular exercises prior to the study and who developed any kind of discomfort during training schedule were also excluded. Consent to participate in a study was obtained from parents of each student. The subjects were called to the department two days prior to the exercise for physical anthropometry, determination of physical fitness, detailed clinical and cardio respiratory examination. Age (yr), height (cm), Weight (kg) were measured using standard Procedures. Body mass Index was calculated by formula from height and weight of the subject. Prior to the introduction of physical training schedule the physical level of study population was assessed by testing the following parameters. Flexibility, Coordination, Equilibrium, Agility, strength and Endurance. Depending on the answers given by the respondents, a scoring scale was developed to classify them in various categories in relevance to their physical fitness measurements.

PRE EXERCISE SCHEDULE

CHOICE OF LOAD

One day prior to exercise, testing subjects were called to the department and the maximal load at which they could cycle on bicycle ergograph was determined, and their age adjusted maximal heart rate was calculated Physiological parameters recorded included resting systolic and diastolic blood pressure, pulse rate at 1 min $ 1.30 min after exercise, respiratory rate within 1 min after exercise and ECG recording by a 12 lead electrocardiograph machine, for S-T seg depression. These parameters were recorded post exercise from day1to day15.In the present study Vo2 max or aerobic power (liters/min) was determined by Astrand's and Rhyming nomogram at a work rate of 67.67 watts. Corrected VO2 max is calculated by multiplying VO2 value by the correction factor, when either maximal HR or age is known. Besides the above parameters, double product is determined (which reveals Myocardial oxygen consumption) and also exercise induced ECG changes are recorded. The students were asked to report at the department by8.30 A.M. Subjects were explained the whole procedure in detail and were motivated prior to the start of exercise. They were told to report immediately if they felt any discomfort, fatigue or dizziness. Subjects rested in supine position for 15 mins before the start of exercise. Stastical Analysis: The mean and standard deviation was calculated for all observations and statistical. Significance using paired 't ' test, correlation coefficient 'r' was calculated.

RESULTS

The age (in years), height (cm), weight (kg) and BMI (in kg/m2) in mean + SD of groups are shown in table 1.

Table 1: Characteristics of study population

Number – 58
Age (years) - 19.707±1.22
Height (cm) - 172.44±6.78
Weight (kg) - 61.181±13.70
BMI (kg/m^2) - 20.357±3.83

Groups were also classified according to BMI

Table 2: Classification of study population based on body mass index

GROUP	No. of Cases	Percentage	Body Mass Index (kg/m^2) mean ± S.D.
I <18 (Underweight)	15	25.87	16.58±1.061
II 18-22.9 (normal weight)	33	56.89	19.90±1.385
III >23 (over weight)	10	17.24	27.52±1.72
Total	**58**	**100%**	**20.357±3.83**

Table 3 Revealed that with training there was a statistically significant decrease in heart rate after 15 days of exercise, while the other parameters did not show any change. The observation also revealed that there was increase in systolic pressure and a fall in diastolic pressure which is not statistically significant. There was no statistically significant change in respiratory rate after 15 days of exercise.

Table 3: Change in cardiorespiratory profile during exercise (n=58)

Day	Heart rate (beats/minute)	Blood Pressure		Respiratory Rate/Minute
		SBP (mms of Hg)	DBP (mms of Hg)	
1	140.24±2.2	172±2.3	66.02±1.3	38.02±1.2
5	141.12±1.2	172±1.2	66.0±1.2	38.00±1.2
15	134±2.2	176±1.2	64.±.02±1.0	36.23±1.6
T	4.1	1.62	1.89	1.90
P	0.001	0.10	0.10	0.10

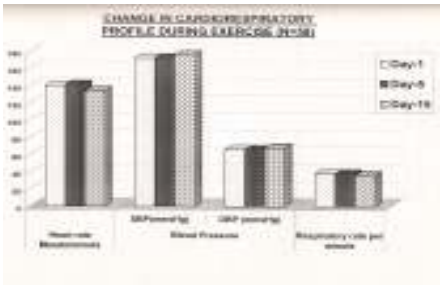

Table 4 reveals that aerobic capacity as assessed by measuring V02 max improves with training. A significant increase in VO2 max was found after 15 days of exercise. The observation suggested that sedentary medical students engaging in regular endurance training could improve
their aerobic work capacity.

Table 4: Change in physiological endurance (vo_2 max l/min) during exercise (n=58)

Day	Cvo2 max L/min	't' day 1 vs day 15	'p'
1	3.1928±0.2404		
5	3.147±0.307	4.08	P.001
15	3.44±0.353		

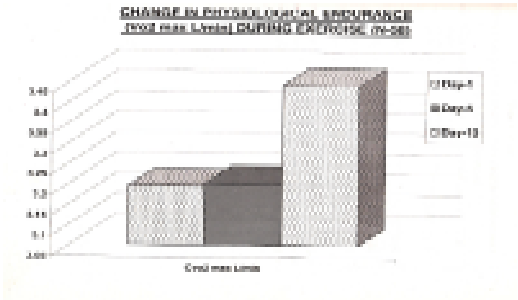

Table 5 suggests the correlation of BMI and mean of corrected VO2 max after 15 days of exercise.A significant positive correlation was found between body mass index and post exercise VO2 max. The study population having normal body mass index showed greater improvement in physical capacity as compared to subjects having high or low BMI.

Table 5: Correlation of bmi and mean of corrected vox2 max after 15days of exercise

GROUP	Body Mass Index (kg/m^2)mean ± S.D.	Post exercise CVo2 max(Liters/min) mean ± S.D.	'r'	'p'
I (n = 15)	16.58 ± 1.061	3.185 ± 0.217	0.80	0.001
II (n = 33)	16.58 ± 1.061	3.68 ± 0.94	0.971	0.001
III (n = 10	16.58 ± 1.061	3.24 ± 0.27	0.982	0.001
Total (n = 58)	**16.58 ± 1.061**	**3.520 ± 0.27**	**0.968**	**0.001**

Table 6 Shows the change in double product during exercise.

Table 6: Change in double product during exercise

Day	Double product	't' Day 1 vs day 15th	'p'
1	24600±3000		
5	23400±3000	4.08	.001
15	22402±3023		

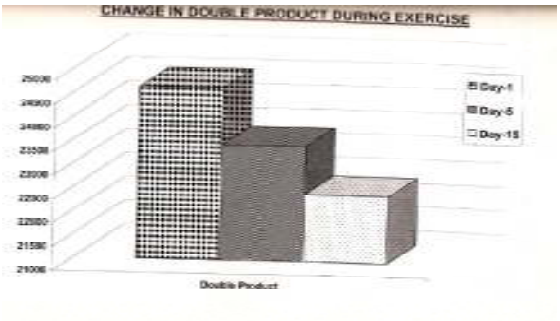

Table 7 suggests exercise induced ECG changes for ST seg depression, which revealed none of the subjects showed ST segment depression > 2 mm.

Table 7: Pre exercise eletrocardiographic finding

Group	Lead	ST - Segment voltage (mm/sec) (Mean of difference, pre and post exercise)
n = 58	III	0.9±0.1
	V_5	1.0

DISCUSSION

In this study, an attempt has been made to evaluate the main health benefits of short term exercise by assessing the effect on cardiorespiratory and aerobic power. The study Population was classified on the basis of BMI. Low BMI has also found to be associated with lower aerobic capacity. 25.87% subjects had BMI< 18 (16.58 + 1.061) indicating poor nutritional status. This suggests that heavy loads of calories coupled with sedentary habits result in obesity and poor physical performance because sedentary habits cannot burn surplus calories. In the present study, heart rate increased with physical exercise done on bicycle ergograph at sub maximal load of 4.3 kg at a speed of 60 rpm for 10 mins. The observed data revealed that heart rate increased upto day 5th linearly, after that the increase in heart rate over the resting heart rate was less. Students ' t' test revealed a statistically significant (t=4.18, P< 0.001 value) decline in heart rate value (table no 3) recorded on day 1 = (140.24± 2.2) and day 15th = (134± 2.2). The finding is of conformity with that of[6] their findings revealed that decrease in heart rate is a biological adaptation resulting from regular exercise. Clinical researches have shown that maximal heart rates can be decreased by training regardless of the exercise employed as reported[7,8] Heart rate reductions during exercise may be related to autonomic control, circulating catecholamine's, increased stroke Volume or a change in the integrating ability of the central nervous system. In present study, there is rise in systolic blood pressure with the training (table no. 3). This could be due to sustained release of catecholamines during submaximal exercise in untrained subjects. The observations revealed a significant difference(t= 9.14 P< 0.001) (table no 3) in preexercise diastolic blood pressure(82.08± 1.28) and post exercise diastolic blood pressure (64+ 1.8) which is not statistically significant. Decrease in diastolic blood pressure(64+1.8) may be due to epinephrine acting on vascular β2 receptors as suggested by[9] The observed data revealed that the systolic and diastolic blood pressure values (SBP 172+ 2.3), 176+ 1.2; DBP 66.02 + 1.3, 68.02+ 1.0) on day 1 $ 15, did not show any statistically significant change with exercise.

Change in double product during exercise

The increased metabolic demand placed on the heart during exercise can be estimated by calculating the double product (heart rate x systolic blood pressure). Double product is suggested to be a good indicator of myocardial oxygen consumption. In the present study a comparison has been made between the calculated values of double product on day 1 and day 15th. The data revealed that myocardial oxygen consumption as measured by double product declined significant after a training period of 15 days. The observations were linked to decreased sympathetic tone in response to regular exercise. In the present study, the heart rate showed a

significant decline with training although blood pressure failed to show any significant change as reported by[10]

Exercise training related ECG changes

In recent years, there are many reports regarding the ECG changes during exercise. To evaluate the exercise induced coronary insufficiency ST segment changes in lead III and V5 were analysed. Downward sloping S-T segment depression, is suggested to indicate the most adverse form of coronary insufficiency. In present study, none of the pre and post exercise electrocardiograms showed ST segment depression > 2mm. According to the guide line set by American heart association, only a depression> 2 mm should be considered as abnormal[11]. The observed findings of the present study revealed that the exercise schedule adopted had no adverse effect on the coronary blood flow. In conclusion, the study came out with the result that the exercise schedule adopted improved the cardiorespiratory fitness and the myocardial efficiency as revealed by the study.

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