CARDIO-RESPIRATORY FITNESS IN HEALTHY MEDICAL STUDENTS OF GULBARGA DISTRICT

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Abstract

Background and Objective: Cardio-respiratory fitness refers to the ability of the circulatory and respiratory systems to supply oxygen to skeletal muscles during sustained physical activity. In the present study, the Cardio-Respiratory Fitness in Healthy Medical Students of Gulbarga District was investigated.

Materials and Methods: The present work was conducted in the Dept. Of Physiology, M R Medical College, Gulbarga after the institutional ethical clearance. In this study, 50 healthy randomly selected students from medical college belongs to same socioeconomic status were included. Exercise was performed and data were recorded using automatic computerized treadmill. Lung Function Tests was performed using computerized vitalography. The data were analysed by paired 't' test followed by one-way ANOVA. P value less than 0.05 was the level of significance.

Results: The result reflects a Significant increase ($p<0.001$) in both pre and post exercise changes and a negative correlation($r= 0.048$, $p=0.05$) between BMI and PFI score was observed. A significant increase ($t=5.16$, $p<0.001$) of exercise induced rise in SBP and no significant difference between pre and post exercise DBP was found. A non-significant change of vital capacity between pre and post exercise and changes of reduction of FEV1 (%) is found to be statistically significant ($p<0.05$).

Conclusion: The percent recovery of heart rate in medical students reflects a better cardiovascular efficiency.

Keywords: Cardio-Pulmonary Functions, Systolic Blood Pressure, Diastolic Blood Pressure Body Surface Area, Body Mass Index, Physical Fitness Index, Forced Vital Capacity, Forced Expiratory Volume in one second

1. Introduction:

Cardio-respiratory fitness refers to the ability of the circulatory and respiratory systems to supply oxygen to skeletal muscles during sustained physical activity. Regular exercise makes these systems more efficient by enlarging the heart muscle, enabling more blood to be pumped with each stroke, and increasing the number of small arteries in trained skeletal muscles, which supply more blood to working muscles. Exercise improves the respiratory system by increasing the amount of oxygen that is inhaled and distributed to body tissue[1]. Cardio-respiratory fitness can reduce the risk of heart disease, lung cancer, type 2 diabetes, stroke, and other diseases. It also helps in improving lung and heart functions[1].

The cardiovascular system is responsible for a vast set of adaptations in the body throughout exercise. It must immediately respond to changes in cardiac output, blood flow, and blood pressure during exercise. Cardiac output is defined as the product of heart rate and stroke volume which represents the volume of blood being pumped by the heart each minute. Cardiac output increases during physical activity due to an increase in both the heart rate and stroke volume[2]. At the beginning of exercise, the cardiovascular adaptations are very rapid. Within a second after muscular contraction, there is a withdrawal of vagal activity to the heart, which is followed by an increase in sympathetic stimulation of the heart. This results in an increase in cardiac output to ensure that blood flow to the muscle matches with the metabolic needs[3]. Both heart rate and stroke volume vary directly with the intensity of the exercise performed. Although the Cardio-Respiratory Fitness was well established in adults, it was not well documented specifically in Medical Students. Hence, the present study was undertaken to investigate the Cardio-Respiratory Fitness in

Healthy Medical Students of Gulbarga District.

2.   Materials and Methods:

The present work was conducted in the Dept. Of Physiology, M R Medical College, Gulbarga after the institutional ethical clearance. In this study, 50 healthy randomly selected students from medical college belongs to same socioeconomic status were included. Students who smoke regularly or occasionally, under medication for major or minor diseases were excluded. All the subjects were asked to perform sub maximal exercise on computerized treadmill-Model Quantum-Q5000. For the sub maximal exercise, 6 minute Exercise was performed using treadmill. Pre-exercise heart rate was recorded. Then asked the subject to walk on the moving ramp of treadmill for 2 grades (Brucee Speed) for 6 minutes (each grade is of duration 3 minutes). At the end of 6th minute, the peak exercise heart rate was recorded. After one minute rest, post exercise recovery heart rate recorded. Weight and height were recorded using standard weighing machines and stadiometer for Calculating Body Mass Index (BMI) and Body Surface Area (BSA). Blood pressure was also recorded by mercury sphygmomanometer.

2.1 Lung Function Tests: Lung Functions were recorded using computerized vitalograph. Data of the subject such as age, height and weights were fed to the instrument before recording each type of lung function test. The predicted values will be recorded by automatic display. All the subjects were made to sit in a comfortable position; the nose clip was put on the nose. A fresh mouth piece was placed in the breathing tube.

2.2 For recording vital capacity, subjects were asked to take deep breath by mouth and then asked to expire forcibly by breathing tube, as much as possible and again asked to take a deep inspiration and stopped. This records the value of vital capacity.

2.3 For FVC & FEV1, subjects were asked to take a deep inspiration by mouth and asked to expire as much as fast by breathing tube once and stopped. This will record the FVC and FEV_1.

2.4 Recovery Heart Rate was calculated by the formula,

Percent of recovery heart rate (RHR)

$$= \frac{B \times 100}{A}$$

Here, A=Peak pre-exercise heart rate and B= Peak post-exercise heart rate.

2.5 Physical Fitness Index was calculated by the formula,

PFI   =

$$\frac{\text{Duration of exercise in seconds} \times 100}{5.5 \times \text{pulse rate } (1 - 1.30 \text{ min. after exercise})}$$

Physical fitness index (PFI) score was calculated and represented as Excellent (>90), Good (80-90), High Average (65-79), Low Average (55-54) and poor (<55).

2.6 Statistical Sigificance: The data were analysed using paired 't' test followed by one-way ANOVA. P value less than 0.05 was the level of significance.

3.   Results:

In the present study, the mean age of medical students selected was 19.4±1.8 years. The height and weight was 174.31 ± 5.30 cms and 61.48 ± 10.26 Kgs respectively. The body surface area (BSA) and body mass index (BMI) was 1.90 ± 0.25m^2 and 20.55 ± 3.64 kg/m^2 respectively. The percentage recovery heart rate was 61.67±16.17 beats per minute (bpm). There was a negative relationship between BMI (kg/m2) and percentage recovery heart rate. The correlation coefficient (r) is 0.45, p<0.05. A decreased statistical significant score (p<0.05) was observed when compared the PFI score before and after the exercise. The percentage of PFI scores Classifications shows 34.4% are excellent category, 27.58% are good category and 37.90% are in high average category. No poor category of fitness is observed. No significant correlation between BMI and PFI score was found (Table-1).

The pre-exercise and post-exercise heart rate was 88.48±13.47 and 153.31±18.55 bpm respectively. A significant increase in the post-exercise heart rate with normal heart rate was observed (t=4.69, p=0.001). The pre-exercise SBP was found to be 119.31 ± 5.30 (mm of Hg). The post exercise SBP was 137.58±7.86 (mm Hg). This finding also reflects a significant increase in systolic blood pressure after exercise (t=10.32, p<0.001).The pre and post exercise diastolic blood pressure was found to be 79.65±4.21 (mm of Hg) and 79.65±4.21 (mm of Hg) respectively. A significant difference of pre and post exercise diastolic blood pressure was observed (t=14.65 & 15.96, p<0.001) (Table-2).

The pre exercise Forced Vital Capacity was 4.05 ± 0.52. The post exercise Forced Vital Capacity was 3.91 ± 0.52. This indicates a statistically non-significant change in the vital capacity between pre and post exercise condition. The pre-exercise FEV_1 was 3.70 ± 0.41. The post exercise change in FEV_1 was found to be 88.30% in comparison to their pre exercise value of 92.09%. The change in FEV_1 was found to be statistically significant ($p<0.05$) (Table-3).

4. Discussion:

The results of the present study showed that Pre-exercise (resting) heart rate was slightly higher than the normal values. But steady increase in peak exercise heart rate reflects a steady rise in oxygen supply to the active tissues in the body. The fall in the recovery heart rate after exercise showed normal healthy cardiac status as the fall is greater than 12 bpm. The percent recovery heart rate reflects a better cardiovascular efficiency. A negative correlation between body mass index and percent recovery heart rate reflects a lesser cardiovascular efficiency in higher body weight individuals due to more sedentary life style of these individuals. Exercise induced rise in systolic blood pressure reflects a normal sympathetic activity on the heart and no changes in diastolic blood pressure reflects the intensity of exercise was really a sub maximal and non exhausting.

Physical inactivity and low cardio-respiratory fitness are recognized as important causes of morbidity and mortality[4-6]. It is generally accepted that people with higher levels of physical activity tend to have higher levels of fitness and that physical activity can improve cardio-respiratory fitness[7]. At the onset of exercise, the ventricular component of the muscles increases by dilation of arteroles[8, 9]. Blood flow shifts significantly from the abdominal viscera to active muscles even during relatively light exercise, which is due to increased sympathetic nervous system out flow and Local chemicals that directly stimulate vasoconstriction or enhance the effect of vasoconstriction[10, 11].

The different cardiovascular adaptation to exercise includes a linear increase in HR with increase in the physical effort. Maximum, HR can be attained during exercise is 220/min. It decreases with advancing age due to generalized reduction of biological function, and Physical training due to (a) increased parasympathetic activity of heart and (b) decreased sensitivity to sympathetic transmitter; because 'psychic' stimuli decreases. The Stroke Volume increases to 2 times the normal value during exercise due to increased in venous return, which is maintained by muscle pump, negative intra-thoracic pressure and modification of tone in capacitance vessels. The Cardiac output increases to 5-6 times during maximum exercise due to increase in heart rate and stroke volume. That is why higher values of maximum cardiac output can be achieved in younger compared to old subjects due to higher maximum HR in young adults.

In our study, No changes of vital capacity and forced vita capacity were found medical students after exercise in comparison to their pre-exercise values. This being reflects that no immediate change of VC and FVC volume occurs after exercise. However, a significant fall of FEV_1 immediately after exercise might be due to exercise induced bronchospasm. Probably leukotriene and histamine are the causative factors to induce post- exercise bronchospasm.

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Table-1: Anthropometrical parameters in medical students. Values are mean ± SD. n=50.

Anthropometric Parameters	Values in mean ± SD
Age(years)	19.4±1.8
Height (cm)	174 ±5.30
Weight (Kgs)	61.48 ± 10.26
BSA (m^2)	1.90 ± 0.25
BMI (Kg/m^2)	20.55 ± 3.64
PFI	86.58±13.40

Note: BSA –Body Surface Area,
BMI –Body Mass Index,

PFI-Physical Fitness Index

Table – 2: Cardiac Parameters in medical students. Values are mean ± SD. n=50.

Parameters	Values in mean ± SD	P Value
Pre-exercise Heart Rate	88.48±13.47	$p<0.001$
Post Exercise Heart Rate	153±18.55	$p<0.001$
Recovery Heart Rate	113.83±21.96	$p<0.001$
Pre-exercise SBP	119.31±5.30	$p<0.001$
Post Exercise SBP	137.58±7.86	$p<0.001$
Pre-exercise DBP	79.65±4.21	NS
Post Exercise DBP	79.65±4.21	NS

SBP-Systolic Blood Pressure,
DBP-Diastolic Blood Pressure,
NS=Non Significant

Table-3: Pulmonary Parameters in medical students. Values are mean ± SD. n=50.

Parameters	Values in mean ± SD	P Value
Pre-exercise FVC	4.05±0.52	$p<0.05$
Post-exercise FVC	3.91±0.52	$p<0.05$
Pre-exercise FEV_1	92.09%	$p<0.001$
Post-exercise FEV_1	88.30%	$p<0.001$

FVC-Forced Vital Capacity,
FEV_1-Forced Expiratory Volume in one second