Assessment of Cardiopulmonary Efficiency Levels in a Student Population

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***Abstract*- Aim**: Evaluation of cardiopulmonary efficiency of medical students. **Methods:** The study was conducted on 200 MBBS students in the age group of 18-24 years, of the D.Y.Patil Medical College, Pune. Height, weight and body mass index (BMI) were measured. The fitness level of an individual was found out by performing breath holding test, 40mm endurance test, maximum aerobic power and physical fitness index. **Result**: Results of this study indicate that these medical students have the minimum physical fitness to carry out their day to day activities.

***Index Terms*-** Breath holding test, 40mm endurance test, maximum aerobic power and physical fitness index.

I. Introduction

A medical student during the course of the medical education is subjected to different kinds of stressors predominantly the pressure of academics leading to the successful completion of the educational course. Physical & mental fitness are the key to such a successful outcome. Physical fitness is used in two close meanings: general fitness-a state of health and well-being and specific fitness -a task-oriented definition based on the ability to perform specific aspects of sports or occupations.It is the result of regular exercise, proper diet and nutrition, and proper rest for physical recovery.There has been a decrease in physical activity due to a more sedentary lifestyle. However evolution has not kept pace with automation and humans have not adapted effectively to the sedentary lifestyles. Inadequate physical activity is responsible for approximately 30% of all deaths mainly due to heart disease, diabetes & colon cancer[1]. Rising levels of obesity are also contributing to these diseases. This has reached epidemic proportions in many parts of the developing world and is beginning to affect developing countries like India as well. Obesity, if present in adolescence leads to obesity in adult life. There is substantial evidence that obesity in childhood lays the metabolic ground work for adult cardiovascular disease[2] .Beginning an active lifestyle could significantly reduce mortality from these events[3] (Paffenberger R.S. et al ,1994). Regular physical exercise is known to have beneficial effects even in the untrained person and in diseased states like Diabetes, Obesity & Hypertension. It was therefore thought to evaluate cardiopulmonary efficiency in medical students to determine the physical efficiency in these students and plan suitable strategies if necessary.

II. Methods

This study was conducted on 200 MBBS students in the age group of 18-24 years, of the D.Y.Patil Medical College,Pune. Height,weight and body mass index (BMI) were measured. Students with BMI less than 18.5 (under weight) and more than 25 (obese) were excluded from the study[4].Students suffering from any physical or medical abnormality were also excluded from the study. Similarly students involved in any kind of physical training were also excluded. Informed consent was taken from all the students.

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. All the experiments were carried out and measurements were taken in temperature of 20° - 25°C.Each subject was given sufficient rest before each experiment to avoid inconsistencies.

The fitness level of an individual was found out by performing the following tests:

Determination of Resting Pulse, Respiration and Blood Pressure

Baseline heart rate, Respiratory rate & blood pressure were measured after five minutes rest in the supine position.

Breath Holding Test:

The subject was asked to take a maximum inspiration after maximum expiration and then hold the breath by plugging the nose as long as possible. The maximum time the subject can hold the breath was noted. [5](proceedings)

40mm Endurance Test (Flack's Air-Force Manometer Test):

The subject was asked to take a deep inspiration, close the nostrils and blow into the mercury manometer to raise the pressure to a level of 40mm Hg. Care was taken so as avoid the use of cheeks to maintain the level of 40mm. During this event, the pulse was noted & was not allowed to increase till the breaking point. The time of breath holding as noted.[5](proceedings)

Determination of VO_2 max(maximum aerobic power)

It is also called as the maximum oxygen uptake or maximum oxygen consumption. Harvard step test (HST) was used as an exercise test for evaluation of maximal aerobic power. The pulse was measured for one complete minute immediately after exercise. Body weight was obtained from

Body weight scale & pulse rate was joined in the Astrand's Ryhming Nomogram to obtain the value of VO_2 max.[6]

Determination of Physical Fitness Index (PFI)

PFI was calculated by measuring heart rate after performing Harvard step test (HST) which is a common method used to assess cardio - respiratory fitness. It is based on the heart rate recovery following a given work load of 5 minutes. The subject was instructed to step up and down on a 51 cm high bench for 5 minutes or up to exhaustion. Exhaustion is defined as the time when the subject cannot maintain the stepping rate for 15 seconds when the rate of stepping is set at 30 cycles per minute.[7-9] Each cycle constituted 1step up and 1 step down. Immediately at the end of this protocol,the subject was asked to sit down. The pulse was counted between 1 to 1.5 minutes, 2 to 2.5 minutes and 3 to 3.5minutes. Fatigue index was calculated as follows:

$$\text{FATIGUE INDEX} = \frac{\text{duration of exercise in sec x 100}}{\text{2 x (sum of pulse counts during recovery)}}$$

The study was approved by the institutional ethics committee. The samples were analysed using the linear regression test. Values are expressed as coefficients and were found to be significant if *p* values were greater than 0.05 & power of the performed test was greater than 0.800. Computations were performed using Sigma-Stat statistical package (Jandel Scientific, version 4 for Windows 95, SPSS Inc., Chicago, USA).

III. Results

Table 1: Physical Fitness Parameters

* Indicates significance where: *p* value < 0.05 and Power of the test > 0.800

Parameter	*p* Value	Power of test
Resting Pulse (beats/min)	0.001 *	1.000 *
Respiratory Rate (per minute)	0.001*	1.000 *
Systolic Blood Pressure (mm of Hg)	0.001*	1.000 *
Diastolic Blood Pressure (mm of Hg)	0.001 *	1.000 *
VO_2 max (lits/min)	0.001*	0.946 *
40 mm Endurance test (in seconds)	0.009*	0.740
Breath Holding (in seconds)	0.004*	0.814*
Fatigue Index (in percentage)	0.001*	1.000*

Measurement of pulse rate was statistically significant with the "p" value of 0.001 and the power of the performed test was 1.000 indicating the normal distribution of the values in this age group. Respiratory rate estimations showed a *p* value of 0.001 and the power of the test was 1.000 which again showed a statistical significance indicating the normal distribution of data. Similar results were obtained for systolic and diastolic pressures with *p* value of 0.0017 and power of the test as 1.000 again indicating a normally distributed data. Estimation of VO_2 max showed a *p* value of 0.009 and the power of the test performed was 0.946 indicating a normally distributed data. Estimations for the 40 mm endurance test showed the *p* value to be significant at 0.004 but the power of the performed test was 0.740 probably indicating that the data distribution was not normal. The *p* value for breath holding was 0.004 that was significant statistically and the power of the test performed was 0.814 again showing the normal distribution of the data. The results for fatigue index showed a *p* value of 0.001 and the power of the test was 1.000 indicating a statistical significance and showing a normal distribution of data.

IV. Discussion

Physical fitness as is normally refers to the ability of an individual to perform physical activity. This is normally slightly different from health related physical fitness that includes components of physical fitness that are associated with some aspect of good health and or disease prevention. This attribute of being physical fit to maintain good health is exceedingly important not only to maintain good health throughout the life of the individual but also to increase longevity of the individual. This becomes critical in the modern world where automation coupled with a sedentary life style and with a western diet has drastically reduced the " good health " of an individual at all ages. This is reflected in the increasing incidences of obesity, cardiovascular diseases, diabetes mellitus & various cancers. These diseases account for the bulk of the deaths from all causes & are the leading causes of death in the developed world. This is assuming epidemic proportions and accounts for a sizeable proportions of the health budgets in the developed world.[10]

This has not spared even the developing world including India. It is predicted that by the year 2025, developing countries will contribute more than half the burden of diabetes in the world and that India will have the largest number of diabetic patients (approximately 57 million) in any one country .[11]This would account for the highest numbers of diabetic patients in any single country & India would be known as the diabetes capital of the world. Obesity, a feature of diabetes and cardiovascular disease is a major complication that is increasingly becoming a feature of even the young population leading to morbidity & even mortality.

It is therefore important to overcome or reduce the cost of this epidemic that is assuming threatening proportions. A very simple and inexpensive alternative would be to get the population into moderate patterns of regular activity. An essential tool in this would be to investigate the ability of the population to carry out physical activity that leads to health related fitness. An ideal age group would be the young individuals as this would allow greater interventions in this age group. This would in the long run lead to a greater reduction in the health budget as also greater reductions in morbidities and mortalities [11]. This study was a pilot study carried out to analyse the physical fitness in the student population of a medical college. This analysis showed that except for 40 mm endurance test the data distribution was normal indicating the values of the variables were near the normal range. It can be concluded that this student population shows the necessary physical fitness and satisfies the minimum requirement in the overall physical fitness regime.

This is important, because it has been observed that behavioural changes like becoming physically active act to delay all cause mortality and extend life [3].Similar observations have been found with other studies which show that death rates of the least fit group were more than 3 times that of the most fit group[12]. The most interesting finding of this study was that the greatest health benefit occurred in the group rated just above the most sedentary group. The drop in the death rate was more than 38 i.e. from 64.0 to 25.5 deaths per 10,000 person years. To move from the most sedentary to the next fit group requires only moderate intensity exercise such as walking briskly for about 30 minutes several times a week.

V. Conclusions

Results of this study indicate that these medical students have the minimum physical fitness to carry out their day to day activities.

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