



ORIGINAL RESEARCH PAPER

Physiology

EVALUATION OF PHYSICAL FITNESS AMONG STUDENT POPULATION USING MODIFIED HARVARD STEP TEST

KEY WORDS: Harvard step test, physical fitness, young adults

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ABSTRACT

AIM: To assess the physical fitness of students of Chengalpattu Medical College, by comparing their pulse rates on performing a modified Harvard step test & to compare the fitness level in relation with the gender..

MATERIALS & METHODS: This study was conducted on 40 students of both genders in the age group of 18 to 24 yrs. Fitness was conducted using Modified Harvard Step Test Protocol which comprises stepping up & down a 30 cm high step at a rate of 30 times/min at a duration of not < 5 min. The total duration of the stepping exercise and post exercise pulse rate after 1 min, 2 min recovery was noted & used for calculating physical fitness index.

RESULTS: The higher the fitness of an individual, lesser is the increase in the pulse rate and faster is the recovery. Statistical analysis showed there is significant relationship between pulse rate recovery with fitness level.

CONCLUSION: This study enable us to determine how life style factors affect cardio metabolic health in early adulthood and insist upon the need for early intervention.

INTRODUCTION

In 1943, during World War II, one of the most popular exercise tests was introduced: the Harvard step test (HST). The HST was developed by professors at Harvard University as a means of assessing the aerobic capacity of young athletes attending that university.(1)

A medical student during the course of the medical education is subjected to different kinds of stresses predominantly the pressure of academics for the successful completion of the educational course. Physical & mental fitness are the key to such a successful outcome.

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.

Inadequate physical activity – Approximately 30% of all death in Heart disease, Diabetic Mellitus, Colonic cancer, etc.¹

A person is said to be Physically fit when he is able to do daily activity with alertness without undue fatigue.²

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^{3,4}

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.

The **Harvard step test** is a type of cardiac stress test for detecting and diagnosing cardiovascular disease. It also is a good measurement of fitness and a person's ability to recover after a strenuous exercise. The more quickly the heart rate returns to resting, the better shape the person is in.

It is a kind of cardiovascular endurance test. The test computes the capability to exercise continuously for extended intervals of time without tiring.

This test was developed by Lucien Brouha and his associates in 1943.⁵

The HST was modified for use in adolescents by Gallagher &

Brouha. The adaptations involved changes in the duration of the test, which was reduced to 4 min, and the height of the step was set at one of two levels (45 cm or 50 cm), according to the body surface of the adolescents. Exercise capacity, estimated from the duration of the test and of the return to the resting HR, was similar in both groups in their study. These data suggested that the height of the step should be adjusted according to the body surface, given that a similar level of work was observed. All adolescents were able to complete the full 4 min of the test without showing extreme fatigue.

METHODOLOGY:

It is a type of Cross-sectional study, conducted among medical students of Chengalpattu Medical College.

The Study subjects: Medical students of both genders in the age group of 18 – 24 years.

Sample size: A total of 133 subjects of which 73 were male and 60 were female whose age varied from 18 to 24 years were selected. Institutional ethical committee approval had obtained.

EXCLUSION CRITERIA

1. Cardio-respiratory problems
2. Musculoskeletal injuries
3. H/o surgeries
4. Leg cramps
5. Fainting
6. Dizziness/nausea/headache
7. Subject request to stop

PROTOCOL

Modified Harvard Step Test⁵

The subjects were asked to be lightly clothed. They were asked to sit quietly for 5 min. Thereafter, they were asked to perform the stepping exercise.

- The person who is taking the test steps up and down on a platform in a cycle of two seconds. The platform is at a height of about 30 cm wooden box. The rate of 30 steps per minute must be sustained for five minutes or until exhaustion. Exhaustion is the point at which the subject cannot maintain the stepping rate for 15 seconds. The subject immediately sits down on completion of the test, and the heartbeats are counted for 1 to 1.5, 2 to 2.5, and 3 to 3.5 minutes.
- Stepping up & down a 30 cm high step box at a rate of 30 times/min at a duration of not < 5 min.
- The total duration of the stepping exercise and post exercise pulse rate after 1 min, 2 min & 3 min will be recorded.

- Those with heart rates above 200 beats per minute, had difficulty in breathing, or unable to finish, were stopped immediately.
- Once the participants have completed the step test or were stopped due to the a fore mentioned reasons, they quickly sit down on the box and rest. Heart rates at 1, 2 and 3 minutes of rest were recorded, as well as total duration of exercise in seconds. The fitness test was conducted under close supervision.
- The detail procedure of exercise test was explained to the subjects & actual demonstration was given before starting test.

RESULTS

- Data was collected and analyzed.
- Height, weight & Physical Fitness Score (PFS), their association and 'paired t' test was done using SPSS version 21.

PHYSICAL FITNESS INDEX

Physical fitness index (PFI) was calculated by the total duration of exercise in seconds × 100 and divided with the 2*sum of three heart rates at 1, 2 and 3 minutes of rest.

Table – 1: Classification of fitness according to Harvard index.

Category	Harvard index
Poor	<55
Average	65- 69
Good	80-89
Excellent	90& above

Table – 2: Shows physical characteristics and PFI in male and female medical students (Mean ± SD)

Sex	No	Height(cm) Mean	Weight (Kg) Mean	PFI (HI) Mean	'p' Value
Male	73	170.5603	56.3219	90.0101	<0.0001
Female	60	156.1400	49.2000	86.2425	<0.0001

The PFI showed highly significant p value among male & female student population of <0.0001.

Males showed excellent fitness score when compared to fitness score of female students.

DISCUSSION

In this study all the subjects continued the exercise step test for 5 min.. The finding in the present study suggests that there is significant difference in physical fitness Index or Harvard index in male and female medical students.

Another study showed that there is significant difference in height and weight in males than female so PFI affects by body size as evidenced in positive co-relation between PFI with height and weight (PK Banerjee et al., 1983).

A similar observation was earlier made by Elbel et al., 1958 (Debnath PK et al., 1978) on college students. The lower mean values of PFI in the female students compared with male students can thus be attributable to their lower body weight and height.

Similar findings were observed in other studies(Ian Gregg et al., 1973) stated this is because male is generally more aggressive and accepts challenge more than female.

Hanifah RA et.al showed that there is inverse association of body composition with Heart rate recovery.

Sharma P et.al suggests that height of subject have +ve correlation with physical fitness score. the reason may be due to maximum tension generated at the optimal length of the muscle. The optimal length of lower-limb muscles depends on the knee angle at the start of exercise while placing the

limb on the bench of a particular height. The knee angle is determined by the length of tibia and femur and, therefore, predominately by the leg length and subject's height. The shorter duration of effort and the lower score in short healthy subjects may be due to muscle fatigue rather than cardio-respiratory impairment.

Considering that the step height is standard, taller people are at an advantage as it will take less energy to climb up onto the step while the lower height of short people hinder the comfortable lifting up and lowering of their legs during the stepping process. This leads to the onset of premature fatigue in their legs.

STRENGTH: This study utilized modified Harvard step test as a tool for fitness assessment, which does not require large space to conduct, minimal equipment and expertise, and a short duration of time to complete (less than 10 minutes).. 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.

LIMITATION: Sample size is less. But for Indians with short stature, it is felt necessary to modify HST and its physiological and anthropometric relations are yet to be explored (Sunil KR et al., 1993). Further studies are needed to compare this step test with other fitness protocols.

RECOMMENDATION:

American College of Sports Medicine recommends daily moderate to vigorous intensity aerobic exercise for ≥60 minutes per day for children². Three hours per week sports participation has shown to reduce body fat and increase fitness level among boys . This is important, because it has been observed that behavioural changes like becoming physically active act to delay all cause of mortality and extend life.¹¹

CONCLUSION

The female student population had average physical fitness score when compared to male student population whose score were good. The shorter duration of effort and the lower score in them may be due to muscle fatigue rather than cardio-respiratory impairment. This study was a pilot study carried out to analyse the physical fitness in the student population of a medical college. It can be concluded that this student population shows the necessary physical fitness and satisfies the minimum requirement in the overall physical fitness regime.

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