

## A CROSS SECTIONAL STUDY OF PHYSICAL FITNESS INDEX USING MODIFIED HARVARD STEP TEST IN RELATION WITH BODY MASS INDEX IN MEDICAL STUDENTS (1<sup>ST</sup> YEAR MBBS) IN MAJOR S.D. SINGH MEDICAL COLLEGE, FARRUKHABAD, U. P, INDIA

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### ABSTRACT

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#### BACKGROUND AND OBJECTIVES

The physical fitness index measures the physical fitness for muscular work and the ability to recover from the work. The Harvard Step Test (HST) assesses the physical fitness of individual. The present study was done to assess the physical fitness index using Modified Harvard Step Test in young adult in the age group of 19 to 28 years with varying degree of physical activity.

#### MATERIAL AND METHODS

Study was conducted in Department of Physiology, Major S.D. Singh Medical College, Farrukhabad. The subjects selected for this study were medical students admitted for first MBBS course and physical fitness index was measured using Modified Harvard Step test.

#### RESULT

The height of subjects positively and significantly correlated to the fitness score and also the duration of exercise. In the present study, the mean Harvard index or PFI was 82.0101 in males 46.2542 in females. Mean value of height and weight were 166.6503 cms and 54.2316 kgs in males 96.4100 cms and 51.9000 kgs in females respectively.

#### CONCLUSION

Low mean value of PFI in female subjects compared to male subjects can thus be attributable to their lower body weight and height; also males are generally more aggressive and accept challenges more than females. This present study is an attempt to modify Harvard step test with classification of score. But for Indians, it is necessary to modify the step test because of short stature.

#### KEYWORDS

Physical Fitness Index (PFI), Body Mass Index (BMI), Modified Harvard Step Test, Medical Students.

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#### INTRODUCTION

Physical fitness implies not only the absence of disabling deformity or disease and the capacity to perform a sedentary task efficiently, but also a sense of physical well-being and the capacity to deal with emergencies demanding unaccustomed physical effort.

Cardiovascular diseases are the leading cause of death worldwide and it has been estimated that 9.4 million deaths each year.<sup>[1,2]</sup> Determination of Physical fitness index (PFI) is one of the important criteria to assess the cardiopulmonary efficiency of a subject. Evidences suggest that sedentary and negative life style habits lead to gradual deterioration of physical well-being and disability as well as incidence of cardiovascular diseases and cerebrovascular accidents. With rapid urbanization, industrialization and increasing level of affluence, load of non-communicable diseases are increasing

tremendously. WHO estimates indicates that globally physical inactivity accounts for more than one-fifth of all the ischaemic heart diseases cases. About 3.3% of all deaths can be attributed to physical inactivity. The lack of physical activity and sedentary lifestyles in the young generation has been a matter of concern in recent days.<sup>[3,4]</sup> Exercise decreases systemic vascular resistance, in which the autonomic nervous system and renin-angiotensin system are most likely the underlying regulatory mechanism.

The Harvard Step Test (HST) was devised by Johnson et al to assess the physical fitness of individual.<sup>[5]</sup> It comprises stepping up and down a step, that is 20 inches (50.8 cm) high at a rate of 30 times/min.<sup>[6]</sup> The higher the fitness of an individual, less is the increase in heart rate and faster is the recovery. However, as the name suggests, the 20" step of the HST is tailored to western anthropometrics and is rather high for Indian, whose height is relatively less. Hence, the Harvard step would pose a greater exercise challenge to the Indian with average height. Therefore, the height of the step is lower (16.5", i.e. 41 cm) in the modified HST that is used in India.<sup>[7]</sup> Application of Harvard step test in the physical performance capacity of an individual has aroused interest because of simplicity veracity of test.<sup>[8]</sup> But for Indians with short stature, it is felt necessary to modify HST and its physiological and anthropometric relations are yet to be explored.<sup>[8]</sup>

Physical fitness is defined as ability to carry out daily tasks with vigor and alertness without undue fatigue with ample

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energy to enjoy leisure time pursuits to meet unusual situations and unforeseen emergencies.<sup>[9]</sup> The American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) recommended this test to study health related Physical Fitness Program in youth.<sup>[10]</sup> Regular physical exercise is known to have been beneficial effects on health. Realizing the fact that diseases are related to lack of fitness, a need to counteract a sedentary lifestyle with planned physical activity through sports and formal exercise is required. This led to the establishment of minimum fitness standards in USA Public School.<sup>[11]</sup> Importance of physical fitness has been mentioned in the history of mankind including Vedas. Yet, physiology of exercise is a recent advancement and is an open field for research. (Wuest and Bucher, 1999).<sup>[11]</sup> It may be mentioned that no physical explanation is given to modify the HST in any country.<sup>[11]</sup> But for Indians with short stature it is felt necessary to modify HST and its physiological and anthropometric relations are yet to be explored.<sup>[12]</sup>

The exercise will help to attain maximum physical fitness due to development of muscle and cardiorespiratory strength as well as endurance of the children. The advantages of physical fitness are many like increase in the level of intelligence, tolerance, activity and social behaviour.<sup>[13]</sup>

The aim of present study is therefore planned to study PFI in both male and female medical students with modified HST along with statistical subdivision to classify the score relatively on a moderate number of subjects. This study may be of use to make the young generation aware about the importance of physical fitness as to prevent lifestyle related chronic diseases.

## MATERIAL AND METHODS

This study was conducted on 100 healthy 1<sup>st</sup> year MBBS Students, of which 70 were male and 30 were female in the age group of 19-28 years after obtaining approval from Ethics Committee of the Institute. Written consent from the subjects was taken before they were considered for inclusion in the study. They were not practicing any athletic events. The detailed procedure was explained as well as demonstrated to the students. The study was conducted in the Department of Physiology, Major S.D. Singh Medical College, Farrukhabad, Uttar Pradesh.

### Study Design

Cross sectional study.

### Study Setting

Major S.D. Singh Medical College, Farrukhabad, Uttar Pradesh.

### Inclusion Criteria

1. Healthy young male and female medical students of first year MBBS.
2. Age group 19-28 years.
3. BMI 18-28 kg/m<sup>2</sup>.

The WHO regards a BMI of less than 18.5 as underweight and may include malnutrition, an eating disorder or other health problems, while a BMI greater than 25 is considered overweight and above 30 is considered obese.<sup>[14]</sup>

### Exclusion Criteria

1. Students with a history of any disorders like diabetes mellitus, hypertension, alcoholism, bronchial asthma, cardiovascular disorders.

2. History of alcohol, smoking habits and tobacco addicts.
3. History of any drug intake.
4. Students who has undergone major surgery.
5. Students with locomotor and musculoskeletal abnormalities.
6. Presence of obesity, anaemia and chronic diseases.
7. Students having any endocrine disorders were excluded from the study.

### Protocol of the Harvard Step Test

In 1943, during World War-II, one of the most popular exercise test was introduced by professors at Harvard University, the Harvard Step Test (HST) for assessing the aerobic capacity of young athletes attending that university.

The subjects were asked to be lightly clothed. They were asked to take rest for 5 min., thereafter they were asked to perform the stepping exercise on a 41 cm high step without shoes. The step used was a heavy wooden step, so that it remained steady during the test. The subject stepped up and down the steps 30 times/min. As the signal starts, the subject places one foot on the platform, steps up places other foot on the platform, straightens both legs and the back bone and then step down bringing down the same foot that he placed up first. The signal "UP" is given at 2s interval. The subjects were directed to lead off with the same foot each time and not the alternate foot. The observer has to call the rhythm by adjusting the metronome. Subject performed this exercise as long as he/she could, but not in excess of 5 min. After the cessation of exercise, the subjects were made to sit quietly on a chair. After exact 1 min., the pulse rate was recorded for 30s. If the subject was dyspnoeic, felt exhausted or felt pain in chest or legs during the exercise, he was asked to discontinue the exercise immediately. The subject performed the exercise for 5 min. unless he stopped earlier due to exhaustion. If the subject could not maintain the stepping rate of 30 times/min. for 20s, he was assumed to be exhausted and the step-test was discontinued.

The weight in kilogram was recorded using a standardized weighing machine. The data were obtained during the routine undergraduate practical experiment in the clinical physiology laboratory between 11:00 am to 1:00 pm. They were clinically examined thoroughly and subjects having resting systolic blood pressure more than 140 mmHg or diastolic more than 90 mmHg were not included in the study.

The duration of the effort to the nearest second was noted using stop watch. When subject completed 5 min., he was asked to stop. PFI score was calculated using the formula.<sup>[15]</sup>

$$\text{PFI} = \frac{\text{Total duration of exercise in seconds} \times 100}{5.5 \times \text{Post exercise 30s pulse count}}$$

If the PFI score is below 50, it is interpreted as poor, between 50-80 as average and above 80 as good.

### Recording of Physical Anthropometry:

1. Height (In cms): This was measured with the subject in standing position without footwear to nearest to 0.1 cms.
2. Weight (In kgs): The subject was weighed with a standard machine with minimum clothing to nearest to 0.1 kgs.
3. Body mass index (kilogram/meter<sup>2</sup>): This was calculated for each subject from his height and weight by using formula.

BMI = Weight in kilogram/Height in meter<sup>2</sup>

**Data Analysis**

Statistical analysis was done using descriptive analysis and chi square test, which includes (Mean, standard deviation) and analysed by Spearman’s correlation test.

**RESULT**

The physical characteristics like age, height, weight and PFI of subjects are given in Table 2. The classifications of fitness according to index are given in Table 3. The physical fitness index rating for both male and female are given in Table 1.

**DISCUSSION**

The modified HST is found to be suitable height for Indian men and women. It may be mentioned here that all the subjects continued the exercise step test for 5 minutes. When step height was 16.4” with step frequency 30/min respectively. 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, because male is generally more aggressive and accepts challenge more than female.<sup>[16]</sup> Also there is significant difference in height and weight in males than females, so PFI affects by body size as evidenced in positive co-relation between PFI with height and weight.<sup>[17]</sup> A similar observation was earlier made by Elbel et al, 1958 and Debnath PK et al, 1978 on male college students. Several studies have established that physical fitness is necessary to carry out daily tasks. The effect of regular exercise is known to have beneficial effect on health.

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. This present study is an attempt to modify test with classification of score. It would be valid for untrained men and women. There was a negative significant correlation between health related anthropometric measures and physical fitness factors as per Leila Jaafari et al (2012),<sup>[18]</sup> Shrivastav et al (2013).<sup>[19]</sup> conducted a similar study on 22 young subjects in the age group of 18-25 years which concluded that there was a negative significant correlation between BMI and aerobic fitness.

Most clinical trials evaluating exercise interventions in Type 2 diabetes have used a frequency of three times per week.<sup>[20]</sup> But current guidelines for adults generally recommend five sessions of moderate activity.<sup>[21]</sup> Aerobic exercise should be at least at moderate intensity, corresponding approximately to 40-60% of VO<sub>2</sub> max (maximal aerobic capacity). For most people with Type 2 diabetes, brisk walking is a moderate-intensity exercise. Additional benefits may be gained from vigorous exercise (>60% of VO<sub>2</sub> max).

Individuals with Type 2 diabetes should engage in a minimum of 150 minute/week of exercise undertaken at moderate intensity or greater. Aerobic activity should be performed in bouts of at least 10 min. and be spread throughout the week. Around 150 min./week of moderate-intensity exercise is associated with reduced morbidity and mortality in observational studies in all populations.<sup>[22]</sup> The benefits of exercise have been promoted by a number of organizations and agencies including the American Heart Association, the American College of Sports Medicine, the General Surgeon of the United States, the National Institute of Health and the Centres for Diseases Control (Wallace, 2003).

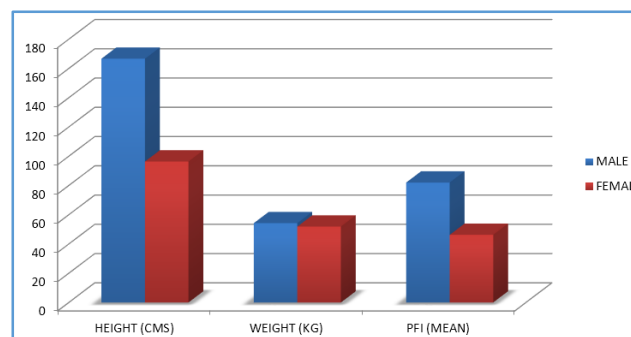
Nutritious food should be taken under the guidance of qualified dieticians and doctors along with monitoring of regular exercise.

PFI Rating	Male	Female
Excellent	>115	>91
Good	103-115	84-91
Fair	91-102	77-83
Poor	<91	<77

**Table 1: Physical Fitness Index Rating.<sup>[18]</sup>**

Sex	No.	Height (cms) Mean	Weight (Kg) Mean	PFI Mean	'P' value
Male	70	166.6503	54.2316	82.0101	<0.0001
Female	30	96.4100	51.9000	46.2542	<0.0001

**Table 2: Shows Physical Characteristics and PFI in Male and Female Medical Students (Mean +- SD)**



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

**Table 3: Classification of Fitness according to Harvard Index**

**Limitation of the Study**

Study was conducted during routine practical sessions of undergraduate medical students; so strict experimental conditions could not be followed. Also, the difference obtained between group A and group B may also be due to gender, as group A predominantly consists of Males. However, further study can be conducted to establish the application of these results.

**CONCLUSION**

Physical fitness of Major S. D. Singh Medical College is not satisfactory due to lack of sporting activity and sedentary lifestyle. The regular physical activity is an important determinant of physical fitness. Overweight decreases physical fitness. Heart rate variability is less among physical fitness individuals.

We conclude from our study that the physical fitness anthropometric parameters are higher in male group. So, regular exercise and nutritious diet under the guidance increases the physical fitness and growth. The nutritious food may be one of the contributing factors in attainment of such growth. Thus, variations in anthropometric parameters are

related to physical exercise and nutritious food.<sup>[23]</sup> Exercise as a lifestyle modification is beneficial to a wide variety of health conditions specific to hypertension. The recommended physical activity participation for person with Type 2 diabetes is aerobic exercise, which should be performed at least 3 days/week with no more than 2 consecutive days between bouts of activity because of transient nature of exercise-induced improvements in insulin action.<sup>[24]</sup> Therefore, it should be included as part of the curriculum to gift physically fit youth of the country.

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