

**Original article:**

## **Cardiac response to exercise determined by physical fitness index in young obese and normal-weight medical students**

**Angesh H. Bagade<sup>1\*</sup>, Megha S. Bhonde<sup>2</sup>, Lalit Nikam<sup>3</sup>**

<sup>1</sup>Assistant Professor, Department of Physiology, Seth G.S. Medical College & KEM Hospital, Mumbai, India

<sup>2</sup>Assistant Professor, Department of Physiology, Chirayu Medical College and Hospital, Bhopal

<sup>3</sup>Professor, Department of Physiology, Seth G.S. Medical College & KEM Hospital, Mumbai, India

\*Corresponding author: Angesh H. Bagade

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### **Abstract**

**Introduction:** Obesity is associated with hemodynamic changes at rest. Whether these changes were reflected during exercise needed to be ascertained. The aim of the study was to assess and compare the cardiovascular response to exercise in young normal weight and over-weight subjects by comparing Physical Fitness Index (PFI) score obtained by Harvard's Step Test.

**Method:** 200 medical students in the age group of 18-25 years were divided into study group consisting of 100 over-weight subjects and control group consisting of 100 normal weight subjects as determined by their Body Mass Index (BMI). For Harvard's Step Test, the subjects were asked to step up and down on an 18 inch high platform at a rate of 20 steps per minute for 5 minutes. The post exercise pulse rate was counted between 1 to 1.5 minutes, 2 to 2.5 minutes, and 3 to 3.5 minutes after completion of exercise. PFI in two groups was calculated and compared in terms of excellent, good, average and poor by "Chi-square test".

**Observations and Results:** The value of Chi-square was found to be 1.261 with DF= 3 and P value of 0.000 which is extremely significant.

**Conclusion:** On comparison, it becomes clear that the normal weight subjects showed a significantly better cardiovascular response to exercise as compared to their overweight counterparts.

**Keywords:** BMI; cardiovascular; overweight; Physical Fitness Index

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### **Introduction**

Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy and increased health problems.

The increased prevalence of obesity among adolescents may be due to modern sedentary life

style, faulty food habits and lack of physical activity. Evidences suggest that sedentary and negative lifestyle habits lead to gradual deterioration of physical well-being and disability as well as incidences of cardiovascular diseases, cerebrovascular accidents<sup>1</sup>.

Regular aerobic exercise induces significant adaptations both at rest and during exercise in a

variety of dimensions related to cardiovascular regulatory system such as cardiac autonomic function i.e. heart rate and blood pressure control.

Students of M.B.B.S course have a schedule consisting of lectures, practical and examinations, due to which making time available for exercise is difficult. Most students of M.B.B.S Course have a sedentary lifestyle. Because of lack of regular physical exercise, good proportion of students tends to be overweight.

Overweight and obesity are associated with hemodynamic changes at rest. Whether these changes are reflected in exercise needs to be ascertained. It is worthwhile to study whether sedentary and mentally strenuous lifestyle is affecting their cardiovascular fitness or not.

Most popular index to compare body composition of people and to categorize them as obese and non obese is the Body mass index (BMI), a measurement which compares weight and height and defines people as overweight when their BMI is between  $25 \text{ kg/m}^2$  and  $30 \text{ kg/m}^2$ , and obese when it is greater than  $30 \text{ kg/m}^2$  (WHO 2000).

This study was aimed to find out whether or not obesity affects cardiovascular functional abilities in young medical students. The subjects were asked to perform Harvard's Step Test which is a simple exercise procedure involving stepping up and down an 18 inch high platform at a fixed pace. The evaluation of this test was done by calculating the Physical Fitness Index (PFI) and comparing appropriately in four categories – excellent, good, average and poor<sup>2</sup>.

The journey from early life obesity to cardiovascular disease would be evident from slow regression of the cardiovascular efficiency in overweight. The result would help plan suitable early interventions at proper time as well as to recommend suitable exercise and lifestyle modification according to their health needs so that health complications in later life due to obesity may be averted.

#### **Aims and Objectives**

The aim of the study was to assess and compare the cardiovascular response to exercise in young normal weight and over-weight subjects by comparing Physical Fitness Index (PFI) score obtained by Harvard's Step Test.

#### **Materials and Methods**

Study was carried out at tertiary health centre of Municipal Corporation of Greater Mumbai on medical students in the age group of 18-25 years who volunteered for it. The ethical committee was informed about the nature of the current study and a permission to conduct the study was obtained. Prior to testing required pre-test instructions were given and test was properly explained and demonstrated. Written informed consent was taken from them before the procedure. 200 medical students of either sex in the age group of 18 – 25 years fulfilling the inclusion criteria were included. Subjects who suffered from any major respiratory or cardiovascular disorder, skeletal or neuromuscular disorder and who had undergone major surgeries were excluded from the study.

The study was carried out by forming 2 groups. One group was the study group, comprising of

100 students who were overweight as determined by their Body Mass Index (BMI). All subjects with BMI more than 15 % above average for their height and weight were included in the study group. The other group was control group, comprising of 100 students who were normal weight.

**Study Procedure**

Prior to testing students were instructed about the

	<b>Fitness category (Physical condition)</b>
>90	Excellent
80-90	Good
55-79	Average
<55	Poor

pre-test preparation. Students were asked to come 3 hours after a light breakfast. They were asked not to indulge in any kind of vigorous exercise within 24 hours prior to test. Their resting heart rate and blood pressure were recorded after giving adequate rest in supine position.

Physical Fitness Index (PFI) was measured by Harvard's step test<sup>2</sup>. An 18 inch stepping platform was used for stepping. Demonstration of the correct stepping procedure was given to each subject. The subjects were asked to stand close to the stepping platform and place the foot completely onto the platform while stepping, straightening the knee and keeping the body erect while standing on the platform. The subjects were asked to step up and down on the platform at a rate of 20 steps per minute for 5 minutes. After completion of the test, the subjects were allowed

to sit comfortably on a chair. The post exercise heart rate was determined using a finger pulse oximeter immediately after completion of exercise. Pulse rate was also counted between 1 to 1.5 minutes, 2 to 2.5 minutes, and 3 to 3.5 minutes.

The Physical Fitness Index score was determined by the following equation:

**Physical Fitness Index (PFI) Score** = (100 x test duration in seconds) / (2 x sum of heart beats in the recovery periods).

Fitness score is classified as follows:

**Table 1: Classification of Physical Fitness Index Score<sup>2</sup>**

Physical Fitness Index (PFI) in two groups was compared in terms of excellent, good, average and poor by "Chi-square test". Analysis was done by SPSS-IS software. The P- value < 0.05 was considered as significant.

**Results**

SPSS software was used for statistical analysis.

**Table 2: Distribution of PFI score between normal weight and overweight subjects**

<b>PFI Score</b>	<b>Normal weight</b>	<b>Overweight</b>
<b>Excellent</b>	23	0
<b>Good</b>	64	8
<b>Average</b>	13	91
<b>Poor</b>	0	1
<b>Total</b>	100	100

$\chi^2 = 1.261$ ; DF= 3; P value = **0.000 (Significant)**

Table 1 shows the comparison of PFI scores in the normal weight and overweight subjects. It was found that the maximum number of normal weight

subjects (64%) were in the GOOD category of PFI whereas the maximum number of overweight subjects (91%) were in the AVERAGE category of PFI. In the study, the value of  $\chi^2$  was found to be 1.261 with DF= 3 and P value of 0.000 which is extremely significant. On comparison of the PFI between the two categories, it becomes clear that the normal weight subjects showed a significantly better PFI score ( $p=0.000$ ) as compared to their overweight counterparts.

### **Discussion**

Obesity is emerging as a serious problem throughout the world, not only among adults, but also children, teenagers and young adults. Of the factors contributing to obesity, sedentary lifestyle and stress seem to be particularly important. Stressful condition leads to irregularity in diet, lack of exercise and addiction, each being considered independent factors leading to obesity<sup>3</sup>. Medical education is stressful throughout the whole course of training. The amount of material to be absorbed, social isolation, pressure of examination, discrepancies between expectation and reality all can be anticipated to bring psychological stress.<sup>4</sup>

In this study, the two groups were compared on the basis of their physical fitness index to assess their cardiovascular response to exercise and level of fitness. The value of  $\chi^2$  was found to be 1.261 with DF= 3 and P value of 0.000 which is extremely significant. On comparison of the PFI between the two categories, it becomes clear that the normal weight subjects showed a significantly

better PFI score ( $p=0.000$ ) as compared to their overweight counterparts.

Physical Fitness Index depends on recovery of the heart rate after exercise and therefore is seen to be less in the overweight group as the overweight group has a higher resting heart rate due to altered sympathetic activity and also the return to resting is prevented by the altered function of the sympathetic nervous system.

Similar findings were obtained by Talay Yar<sup>5</sup> in his study comparing resting heart rate in normal weight and overweight students. He concluded that there is a significant positive correlation between obesity indices and resting heart rate with the obese group exhibiting a significantly faster resting heart rate compared to normal weight group.

### **Conclusion**

The physical fitness index scores (PFI) were found to be much better in normal weight subjects as compared to overweight subjects. This indicated a deteriorated cardiovascular efficiency in the overweight subjects as compared to normal. This study shows that young overweight adults have a poorer cardiovascular response to exercise as compared to normal individuals. The results of this study emphasizes the need for early identification of the risk factors leading to excessive weight gain and initiation of preventive measures in order to prevent the deterioration of cardiovascular performance in susceptible young adults.

**References**

- 1) Hill JO & Trowbridge FL. Symposium on the causes and health consequences of obesity in children and adolescents. *Pediatrics* 1998; 101: S497-S574.
- 2) Brouha I, Health CW, Graybiel A. Step test simple method of measuring physical fitness for hard muscular work in adult men. *Canadian Review* 1943; 2:86.
- 3) Kolata G. Rethinking thin: The new science of weight loss – and the myths and realities of dieting. *Picador* 2001; 122.
- 4) Srinivasan K, Vaz M, Sucharita S. A Study of stress and autonomic nervous function in first year undergraduate medical students. *Ind J Physiol Pharmacol* 2006; 50:257-64.
- 5) Talay Yar. Resting Heart Rate and Its Relationship with General And Abdominal Obesity In Young Male Saudi University Students. *Pak J Physiol* 2010;6(1)