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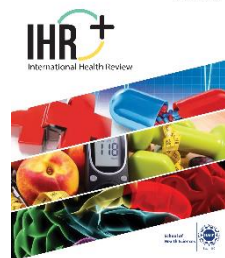
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**Title:** Determination of Physical Fitness Index (PFI) among Female College Students

**Author (s):** Saffa Tariq<sup>1</sup>, Zohaib Anwar Solangi<sup>2</sup>, Ameer Hamza<sup>3</sup>, Syed Zamin Abbas<sup>4</sup>, Ayesha Iftikhar<sup>5</sup>, Usama bin Sabir<sup>6</sup>, and Abdul Hanan<sup>7</sup>


**Affiliation (s):** <sup>1</sup>University of Lahore, Pakistan  
<sup>2</sup>Royal Institute of Physiotherapy & Rehabilitation Sciences, Sukkur, Pakistan  
<sup>3</sup>Mehboob International Eye and General Hospital Gandhian, Mansehra, Pakistan  
<sup>4</sup>Mirpur Institute of Health Sciences, Azad Kashmir, Pakistan  
<sup>5</sup>Mirpur Institute of Medical Sciences, Azad Kashmir, Pakistan  
<sup>6</sup>Al Kareem Medical Complex Multan, Kaims International Institute Multan, Pakistan  
<sup>7</sup>University of Chenab, Pakistan

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# Determination of Physical Fitness Index (PFI) among Female College Students

Saffa Tariq<sup>1</sup>, Zohaib Anwar Solangi<sup>2</sup>, Ameer Hamza<sup>3</sup>, Syed Zamin Abbas<sup>4</sup>, Ayesha Iftikhar<sup>5</sup>, Usama bin Sabir<sup>6</sup>, and Abdul Hanan<sup>7\*</sup>

<sup>1</sup>University of Lahore, Pakistan

<sup>2</sup>Royal Institute of Physiotherapy & Rehabilitation sciences, Sukkur, Pakistan

<sup>3</sup>Mehboob International Eye And General Hospital Gandhian, Mansehra, Pakistan

<sup>4</sup>Mirpur Institute of Health Sciences, Azad Kashmir, Pakistan

<sup>5</sup>Mirpur Institute of Medical Sciences, Azad Kashmir, Pakistan

<sup>6</sup>Al Kareem Medical Complex, Pakistan

<sup>7</sup>University of Chenab, Pakistan

## ABSTRACT

Physical fitness/cardiovascular fitness is considered as the best reflection of whole-body health. It can be maintained by improving the physical fitness/cardiovascular fitness levels of individuals. The current study attempted to analyze the physical fitness index (PFI) of female college students by using the Harvard step test. A cross-sectional research was conducted from June 2021 to January 2022. Non-probability convenient sampling technique was employed to choose a sample of 340 students based on inclusion and exclusion criteria. Data was collected from Government Degree College for Women, Government Post-Graduate College for Women, and Apex College Sialkot, Pakistan. The data was entered and analyzed through SPSS. PFI scores showed students who had excellent and good scores, for instance 13 (3.8%) and 39 (11.5%), respectively. High average and low average scores were 172 (50.6%) and 62 (18.2%), respectively. Students who had poor scores were 54 (15.9%). The mean PFI was  $66.91 \pm 11.23$ , respectively. The association of PFI with BMI showed spearman correlation value as 0.136 with p-value  $< 0.05$ . The findings showed that most of the female college students had average to low PFI.

**Keywords:** cardiovascular index, Harvard step test, physical fitness Index (PFI), physical activity

## 1. INTRODUCTION

Physical fitness is a multifaceted conception and has been identified as a set of characteristics which people have or develop that relates to their

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\*Corresponding Author: [hannan\\_pasha@yahoo.com](mailto:hannan_pasha@yahoo.com)

capacity to perform any physical activity [1]. The Physical Fitness Index (PFI) assesses physical fitness to carry out muscular work as well as the capacity to recuperate from labour. An individual is deemed fit for a specific work or activity if he can do it with a decent degree of efficiency, without undue exhaustion, and with a quick recovery from the effect of exertion [2].

Physical activity refers to any action performed by the skeletal muscles of an individual that leads towards the consumption of energy [3]. Fitness is further subdivided into health-related and skill-related factors, with the health aspect including cardio-respiratory endurance, muscular endurance, strength of muscles, and adaptability. Physical inactivity is responsible for around 3.3% of all fatalities. A widespread worry has been seen over young generation's lack of physical exercise and sedentary lifestyles in recent years. Exercise reduces the systemic vascular resistance. The more fit a person is, the less their heart rate would be, and they would recover quickly [4].

Astrand-Rhythming bicycle ergometer test, YCMA bicycle ergometer test, variety test of treadmill protocols, and Cooper's 12-minute run walk estimate cardio-respiratory fitness [5]. A maximally paced 1-mile walk test, called the Rockport Fitness Walking Test (RW), is used to assess the individuals' cardiorespiratory fitness by estimating or predicting their maximum oxygen uptake (VO<sub>2</sub>max) [6]. The comparison of Chester step test with maximum oxygen consumption (VO<sub>2</sub>Max) was determined during a treadmill test. Chester step test is a submaximal test to predict the aerobic capacity [7]. Several techniques are available to quantitatively evaluate one's physical prowess among which the Harvard fatigue step test is employed [8]. The Harvard step evaluates a person's level of physical fitness [9]. The Harvard step test is a basic fitness test for intense muscular exertion. It takes no specific talent on patient's side and can be used for healthy children, adolescents, or adults of any gender with suitable changes. The "fitness index" of this test is effective in allocating people to jobs within their physical capabilities and assessing responsiveness to physical training. Fitness index is unrelated to height, weight, leg length, or pelvic breadth, although patients with a slow resting pulse have a higher fitness index [10]. The Harvard step test has a validity and reliability of 0.6 to 0.8 [11].

Rismia Agustina et al conducted a study in 2020 on cardiorespiratory endurance in college students involved in smoking using Harvard step test. According to the results, 47.5% of participants performed poorly, 42.5%

performed averagely, and 10% performed well on Harvard step test. According to the findings, half of college student smokers obtained a low Harvard step test score as a measure of cardiorespiratory endurance [12]. Another study was conducted to assess the extent of physical fitness and level of mental strain in exercising and non-exercising physical therapy students. The study revealed that the exercising group had greater physical fitness and lesser mental stress level as compared to the non-exercising physical therapy student group. Physical fitness and mental strain have an inversely proportionate, highly significant, and moderate relationship in strength correlation. This suggests that an improvement in physical fitness leads to a reduction in mental stress [13].

Despite extensive research on the topic of physical fitness, there is a conspicuous gap in literature concerning the specific fitness index of female college students which is vital considering their unique physiological makeup and health needs. The rationale for the current study, that is, "Determination of Physical Fitness Index (PFI) among Female College Students", stems from the necessity to fill this void of knowledge. Moreover, it also provides a granular understanding of their fitness status, thereby contributing to the development of tailored fitness interventions. The objective was to meticulously evaluate the PFI among female college students. This initiative is significant since it not only fosters health consciousness among the target demographic, however, it also aids in drawing correlations between physical fitness and academic efficacy. The insights gleaned from the current study would equip educators, policymakers, and health professionals with the data needed to craft and enforce effective physical education curricula and health policies. Hence, there would be a positive influence on the long-term health trajectories and academic outcomes of female college students.

## 2. MATERIALS AND METHOD

The current study followed a cross-sectional research design, conducted during the time period June 2021 to January 2022. The duration of the study was seven months. The study settings included Government Degree College for Women Qila Kalar Wala, Government Degree College for Women Satrah, and Apex College Wadala Sandhuwan. The sample size of the study consisted of 340 female college students. Convenient sampling approach was utilized to recruit research participants. The inclusion criteria of current study comprised non-diseased young under-graduate and graduate female

college students who were willing to participate in the study. The exclusion criteria of the current study included physically handicapped participants, those having cardio-respiratory disorders, hypertensive students, and those unable to perform test. Participants were selected according to the selection criteria. The data regarding age, gender, height, and weight was obtained.

Participants in the current study signed the consent form and completed the PAR-Q (physical activity readiness) questionnaire. PAR-Q analyses the safety of performing tests and the danger of developing heart issues during exercises. If the individuals replied YES to any of the PAR-Q questions, they were eliminated. Body Mass Index (BMI) was computed using the Quetelet Index which is a statistical assessment of a person's weight scaled by height. Adolphe Quetelet, a Belgian polymath, invented it in 1832. BMI was determined using the following formula:  $BMI = \text{Weight in kg} / \text{height in m}^2$ .

To perform Harvard step test, subjects were given rest for 5 minutes on a chair and resting heart rate was measured. The participants were made to stand facing the step and were then directed to start as timer starts. They were asked to get ready so that the timer would be started. Timer was started and participants were allowed to step up, up; down, and down. It was made sure whether the participants are accurately maintaining the rhythm and correct it if necessary (“speed up,” “slow down,” ). Participants were informed about the time (“two minutes,” “one minute,” “30 seconds left,”). When 30 seconds were left, they were reminded to sit down quickly and wait for their heart rate to be recorded. At completion, participants were asked to sit on chairs. The researcher palpated radial artery, put index and middle finger above artery while pressing middle finger comparatively more to take pulse rate and started taking pulse rate 1 minute after exercise from 1-1.5 minutes post exercise. This was pulse rate 1. Afterwards, the researcher took pulse rate 2, 2-2.5 minutes after exercise. Pulse rate 3 was taken 3-3.5 minutes post exercise [14]. Obtained values were used to calculate PFI using the formula, that is,  $PFI = \text{Duration of exercise in seconds} \times 100 / 2(\text{pulse 1} + 2 + 3)$ .

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

where,

- PR1 (Pulse Rate 1) – 1 min after exercise

- PR2 (Pulse Rate 2) – 2 min after exercise.
- PR3 (Pulse Rate 3) – 3 min after exercise.

Participants' fitness was graded on the basis of PFI as poor, low average, high average, good, and excellent.

### **2.1. Ethical Consideration**

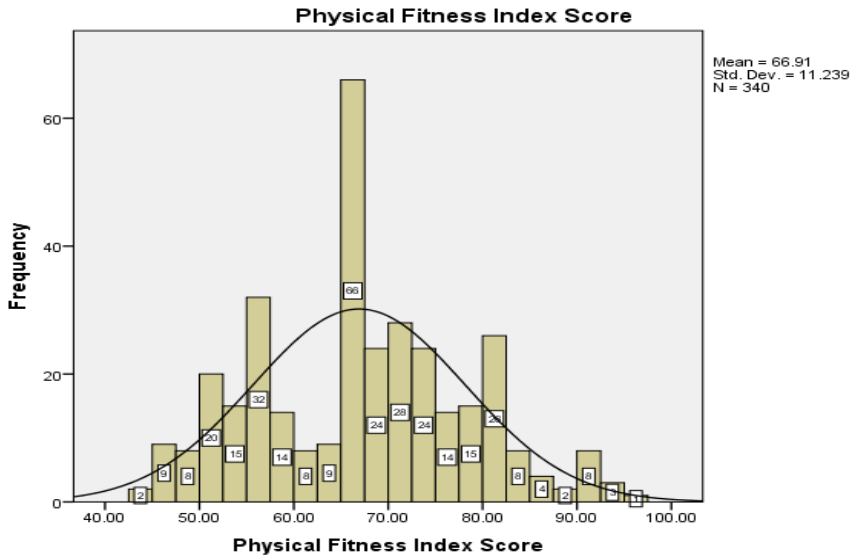
All ethical concerns were taken into account. The current study received the ethical approval from institutional review board of "University of Lahore". The participation in the research was entirely voluntary. The privacy and dignity of all participants was prioritized. All the collected data was kept confidential.

### **2.2. Statistical Analysis**

SPSS version 20.0 was used to enter and analyse the data. Categorical data was presented in the form of frequencies and percentages. The Shapiro Wilk test was used to determine the normality of numerical data. For numerical normal, the mean and standard deviation were computed. *p*-value 0.05 was considered significant for descriptive analysis. All the results were calculated with 95% confidence.

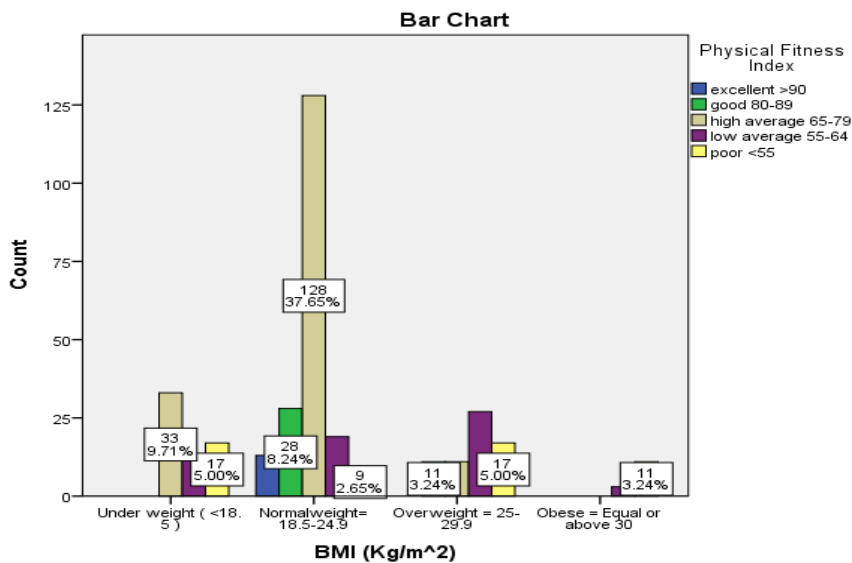
## **3. RESULTS**

A total of 340 students were included in the current study who had to meet the criteria of PAR-Q questionnaire to participate in the project.



**Figure 1.** Frequency of Physical Fitness Index (PFI) Score

Figure 1 shows the frequency of PFI among female college students that was observed as average Physical Fitness Index (PFI)  $66.91 \pm 11.239$ .



**Figure 2.** Body Mass Index (kg/m<sup>2</sup>) at Different Levels of Physical Fitness Index (PFI)

Figure 2 shows count of Body Mass Index (BMI) (kg/m<sup>2</sup>) among female college students at different levels of PFI where underweight category (<18.5) had 33(9.71%) high average (65-79) score of PFI, and that of poor(<55) were 17(5.00%). In normal weight (18.5-24.9) category; 28(8.24%) of females had good (80-89) score, 128(37.65%) had high average, and 9(2.65%) of females had low average (55-64) score. Among overweight (25-29.9); 11(3.24%) of females had high average (65-79) score and only 17(5.00%) of them had poor (<55) score. In obese participants, ( $\geq 30$ ); 11(3.24%) of females had poor(<55) score of PFI.

Table 1 represents the distribution of PFI, BMI, and resting pulse rate among participants. It shows that out of total 340 females, 63(18.5%) of the participants are under weight, 197(57.9%) of them have normal weight, 66(19.4%) are overweight, and only 14(4.1%) are obese. Out of total 340 participants, 13(3.8%) showed excellent score, 39(11.5%) of them showed good score, 172(50.6%) showed high average score, 62(18.2%) showed low average score, and 54(15.9%) of them had poor score of PFI. Out of total 340 college females whose resting pulse rate was taken, 63(18.5%) of the participants were under weight, 197(57.9%) of them had normal weight, 66(19.4%) were overweight, and only 14(4.1%) were obese. The distribution of BMI, resting pulse rate, and PFI among participants in terms of mean $\pm$ SD was 23.9796 $\pm$  8.33973, 81.4529 $\pm$  6.69434, and 66.9115 $\pm$  11.23899, respectively.

**Table 1.** Distribution of Physical Fitness Index (PFI), Body Mass Index (BMI), and Resting Pulse Rate

Variable	Categories	n(%)	Mean $\pm$ SD
Physical Fitness Index (PFI)	Excellent >90	13(3.8)	66.91 $\pm$ 11.23
	Good (80-89)	39(11.5)	
	High average 65-79	172(50.6)	
	Low average 55-64	62(18.2)	
	Poor <55	54(15.9)	
	Total	340(100)	
Body Mass Index (BMI)	Underweight ( <18.5)	63(18.5)	23.97 $\pm$ 8.33
	Normal weight (18.5-24.9)	197(57.9)	
	Overweight (25-29.9)	66(19.4)	
	Obese $\geq 30$	14(4.1)	



Variable	Categories	n(%)	Mean± SD
	Total	340(100)	
	BMI classification	n(%)	
Resting pulse rate	Underweight (<18.5)	63(18.5)	81.45± 6.69
	Normal weight (18.5-24.9)	197(57.9)	
	Overweight(25-29.9)	66(19.4)	
	Obese(≥30)	14(4.1)	
	Total	340(100)	

Table 2 represents the association between BMI and PFI giving the values of chi-square, spearman correlation, and p-value, that is, <0.001 which means that p-value is statistically significant. However, there is a weak association between PFI and BMI.

**Table 2.** Association between BMI and Physical Fitness Index (PFI)

Association	chi-square	Spearman Correlation	p-value
Physical Fitness Index with BMI	0.175	0.136	0.001

#### 4. DISCUSSION

Physical fitness is a comprehensive notion that has been defined as a set of characteristics that people already have or develop which is related to their capacity to perform any physical activity [1]. The current study attempted to use the Harvard step test to measure the PFI of female college students. The distribution of BMI, resting pulse rate, and PFI among participants in terms of mean±SD was 23.9796± 8.33973, 81.4529± 6.69434, and 66.9115± 11.23899, respectively. The association between BMI and PFI using chi-square, spearman correlation showed p-value <0.001 which means that p-value was statistically significant, however, there was a weak association between PFI and BMI.

Mahajan and Rawat [15] conducted a research in which 242 physiotherapy students were evaluated for PFI and its relationship with BMI for the age range of 18-25 years. Participants were requested to step up and down on a 20-inch high step for men and an 18-inch high step for women for 5 minutes at a rate of 30 times per minute. According to the findings, 84.71% of the students were physically inactive. None of the contestants were in good or outstanding shape. The interpretation of PFI results for 242

pupils was determined to be bad for 84.71%, low average for 14.05%, high average for 1.24%, good for 0%, and exceptional for 0% [15]. The current study was conducted on female college students with a sample size of 340 females using 33cm high Harvard step bench. They were asked to step up and down on it. Results showed that 63(18.53%) of them were under weight(<18.5). Most of them had normal weight (18.5-24.9), that is, 197(57.84%). About 66(19.41%) of the females were overweight (25-29.9) and only 14(4.118%) of them were Obese ( $\geq 30$ ). As far as PFI of participants is concerned, only 13( 3.824%) females had excellent (<90) PFI. About 39(11.47%) of them were at good (8-89) level. Most of the females showed high average (65-79) PFI score of 172(50.59%). About 62(18.24%) of them were at low average (55-64) level. About 64(15.88%) of females had poor (<55) PFI score.

The current study was conducted on female college students using 33cm high step bench for 5 minutes which showed that 3.8% of students had excellent scores, while 15.9% had poor PFI. About 11.5% of them had good PFI score which is comparatively less than the above mentioned study. About 68.8% of the females had fair PFI score. The current study also showed statistically significant results at  $p < 0.001$ .

Parmar et al. on another occasion conducted a physiotherapy on male (48) and female (57) students for PFI. Subjects were instructed to perform a modified Harvard step test in a rhythmic way for 5 minutes on a 33cm bench. The results showed that 57% students had excellent PFI. About 49% of students had poor physical fitness. It was determined that 53% of students had good PFI score. The study showed significant results with  $p$ -value  $< 0.05$  [2].

Rismia Agustina conducted a study titled “Cardiorespiratory Endurance on College Student Smokers Using Harvard Step Test”. In this study, 40 male college smoker students were selected with normal BMI where only 10% of them had good PFI score, 42.5% had average score, and 47.5% had good score. Subjects were instructed to complete the Harvard step test by going up the bench as high as 19 inches for a maximum of five minutes (40). The current study was conducted on 340 healthy female college students stepping up/down on a 33cm high step bench including all the BMI classes. It was showed that 11.5% of the students had good score, 68.8% had average score, and 15.9% of them had poor score of PFI.

The limitations of the current study are described as following:

The use of questionnaires may restrict the efficacy of study, since certain items may not be answered completely owing to participants' inability to remember. Overweight/obese people have to face difficulty in performing the test, while those with normal weight can perform test without undue fatigue. Test is time consuming, therefore administration of test on a large population is difficult.

#### **4.1. Conclusion**

The current study concluded that most of the students had average score of PFI. Very few of them had excellent and good scores. The findings indicated that PFI of female college students was not satisfactory. Therefore, physical fitness of young females needs to be improved in order to increase their level of fitness. There is a need to make students aware of the importance of physical fitness in their daily lives and motivate them to achieve their optimal fitness levels.

#### **4.2. Recommendations**

**4.2.1. Implement Awareness Programs.** Initiate regular physical fitness awareness and educational campaigns within colleges to highlight the importance of maintaining optimal fitness levels and promote a healthy lifestyle among female students.

**4.2.2. Promote Physical Activity.** Colleges should actively promote and organize diverse sports and physical activities tailored to female students' interests and fitness levels, providing accessible facilities and opportunities for regular exercise.

**4.2.3 Conduct Regular Assessments.** Introduce routine fitness assessments and offer personalized fitness plans for female students to monitor, improve, and maintain their physical fitness levels over time.

#### **CONFLICT OF INTEREST**

The author of the manuscript has no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

#### **DATA AVAILABILITY STATEMENT**

The data associated with this study will be provided by the corresponding author upon request.

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