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"STUDY OF PHYSICAL FITNESS INDEX USING MODIFIED HARVARD STEP TEST IN RELATION WITH GENDER IN IT STUDENTS: CROSS SECTIONAL STUDY".

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ABSTRACT:

Background
Physical fitness is an important indicator of overall health and functional capacity. Modern lifestyles, particularly among Information Technology (IT) students, are increasingly sedentary due to prolonged screen time, academic workload, and reduced physical activity. Such lifestyle habits can negatively affect cardiovascular endurance and overall physical fitness. The Modified Harvard Step Test (MHST) is a simple, reliable, and economical method used to evaluate cardiovascular efficiency and determine the Physical Fitness Index (PFI). Therefore, assessing the PFI among IT students is essential to identify their fitness levels and promote awareness about maintaining an active lifestyle.

Keywords:

Physical Fitness Index, Modified Harvard Step Test, Cardiovascular Endurance, IT Students, Sedentary Lifestyle

Introduction:

The Physical Fitness Index (PFI) measures physical fitness for muscular work and the ability to recover from work. Fitness is divided into health-related and skill-related components. The health-related component further consists of cardiorespiratory endurance, muscular endurance, muscular strength, and flexibility.[1]

Physical fitness is defined as "the ability to carry out daily tasks with vigour and alertness, without undue fatigue and with ample energy to enjoy leisure time pursuits and to meet unforeseen emergencies.[3]

Physical fitness has three main aspects: static fitness (absence of disease), dynamic fitness (ability to perform strenuous work), and motor skill fitness.[2] Physical fitness is also described as a set of attributes that a person possesses or achieves which are related to the ability to perform physical activity.[3] Just as the amount of physical activity ranges from low to high, the level of physical fitness also varies accordingly.[3]

College is an important phase of life where academic, personal, social, physical, and emotional aspects intersect**.** In demanding professional courses such as engineering and information technology programs, students often neglect healthy eating habits and regular physical activity due to academic pressures. These unhealthy habits developed during college years may continue into adulthood. Therefore, it is important for students to maintain healthy lifestyles, as they play an important role in shaping the future workforce and society.[10]

Students during their curriculum face various types of academic pressure and stress, as well as due to a more sedentary lifestyle, their physical fitness levels may decline. Therefore, there is a need to evaluate the physical fitness levels of IT professionals so that they can adopt healthy habits early in their careers and remain motivated to maintain a healthy lifestyle throughout life.[10]

Many countries have witnessed a significant rise in obesity rates over the past three decades due to increasingly sedentary lifestyles, urbanization, industrialization, and the consumption of processed foods and high-calorie diets.[4]

The Physical Fitness Index (PFI) is widely used to measure physical fitness for muscular work and the ability to recover from exertion. The present study was undertaken to assess the physical fitness index using the Modified Harvard Step Test**.**[5]

The Harvard Step Test (HST**)** has gained attention as a simple and reliable method to evaluate the physical performance capacity of an individual. It is widely used to assess cardiovascular endurance and overall physical fitness.[9]

The Harvard Step Test was originally introduced by Brouha and colleagues in 1943 at the Harvard Fatigue Laboratory in the United States to evaluate the physical fitness of army personnel during World War II. The test later became widely used in physical education and sports science to evaluate cardiovascular fitness.[19]

In this test, a student steps up and down on a modified Harvard step bench (approximately 33 cm height) at a rate of 30 steps per minute for 5 minutes. Immediately after completing the exercise, the participant sits down and the pulse rate is measured by palpating the radial artery between 1 minutes, 3 minutes, and 5 minutes during recovery.[7]

The need for simple, reliable, and valid methods for evaluating physical fitness arises from the importance of physical fitness as a key indicator of health and functional capacity.[8]

Gender differences in physical fitness have been widely reported in the literature, with males generally demonstrating greater aerobic capacity, muscular strength, and work capacity compared to females, largely due to physiological differences such as higher muscle mass, hemoglobin concentration, and hormonal influences.[12]

Research conducted among physiotherapy and medical students has also demonstrated variations in physical fitness levels between males and females, highlighting the need to assess and monitor the fitness status of healthcare students.[10] Furthermore, lifestyle factors and participation in physical activities often differ between genders, with females frequently reporting lower levels of vigorous physical activity than males, which may contribute to differences in overall physical fitness.[20]

Therefore, assessment of physical fitness using standardized methods such as the Modified Harvard Step Test is important for understanding gender-based variations and promoting better health and fitness among students.

Need of the study:

Gender differences in physical fitness have been widely discussed in the field of Exercise Physiology and Sports Science. Physiological differences between males and females—such as muscle mass,

aerobic capacity, and hormonal influences—can influence their physical performance and recovery rates. However, the lifestyle patterns of IT students may reduce these differences or create new trends that need to be examined scientifically.
Despite the importance of physical fitness, many IT students do not engage in regular physical activity due to academic workload, sedentary lifestyle, and excessive screen time. As a result, their cardiovascular fitness may decline, which could affect their health, productivity, and quality of life. Conducting a study on the Physical Fitness Index among IT students will help to identify their current fitness levels and highlight the need for improved
physical activity programs.

Furthermore, examining the relationship between Physical Fitness Index and gender will help educators, health professionals, and institutions understand whether there are significant differences between male and female IT students in terms of cardiovascular endurance. The findings of this study may help in designing gender-appropriate fitness programs and promoting healthy lifestyle practices among students.

Therefore, the present study is needed to assess the Physical Fitness Index using the Modified Harvard Step Test and to analyze its relationship with gender among IT students. The results may contribute to the development of awareness and strategies for improving physical fitness and overall health among students in the IT field.
There are very few studies are done on physical fitness in IT students focusing on gender diffrencese in physical fitness.

Therefore, the present study aimed to determine the diffrence in physical fitness index of male and female IT students in latur, Maharashtra

1. Population and sample size

The target population for this study comprises Information Technology (IT) students at Cocsit college in latur. IT students were specifically selected for this population pool because their academic and future professional routines demand prolonged sitting and high screen time, making them a highly relevant demographic for assessing sedentary lifestyle impacts on cardiovascular endurance.
A cross-sectional research design was adopted for this study. The sample size consists of 110 IT students, divided equally into two strata based on gender 55 males and 55 females to allow for an accurate comparative analysis.
Sampling Method: A stratified random sampling technique was utilized to select the participants.

Inclusion Criteria:
Students aged between 17 and 24 years, actively enrolled in IT courses.

Exclusion Criteria:

- Student with Locomotor& Musculoskeletal disability.
- History of Cardiovascular and respiratory disorders.
- History of Diabetes mellitus and hypertension.
- History of Major surgery in the recent past.
- History of Alcohol & Smoking [1].

2. Data and Sources of Data

The data was collected directly from IT students studying at Cocsit college in Latur city.
Testing Method: The primary tool used for data collection was the Modified Harvard Step Test. Participants performed the step test, and their recovery pulse rate were recorded to calculate their Physical Fitness Index (PFI).
The data was specifically categorized and recorded based on the gender of the IT students to allow for a direct analysis between males and females.

3. Theoretical framework

The theoretical framework of this study is grounded in the Academic Lifestyle Behaviors, specifically focusing on the cardiovascular endurance of IT students.

The Sedentary Nature of IT Education: The framework begins with the premise that IT studies necessitate prolonged periods of physical inactivity. According to prevailing health theories, chronic sedentary behavior is directly correlated with a decline in cardiovascular fitness and aerobic capacity (VO_2 max). The study posits that the academic lifestyle of IT students creates a distinct need for early fitness evaluation.

Physical Fitness Index (PFI) as a Metric: The theoretical basis for using the Modified Harvard Step Test lies in its proven validity as a measure of aerobic fitness and cardiovascular recovery.

Gender-Based Physiological Variances: The framework incorporates established biological theories regarding gender differences in physical fitness. Generally, physiological differences such as cardiac output, lung volume, and hemoglobin concentration result in differing baseline aerobic capacities between males and females. By examining PFI in relation to gender, this study tests the hypothesis of whether the sedentary impact of IT studies affects both genders equally or disproportionately, thereby providing a targeted understanding of fitness levels in this specific academic demographic

Methodology:

- **Study Design**: observational study.
- **Study type**: cross sectional study
- **Study duration**: 6 month
- **Study population**: IT students in the age group of 17-24years
- **Study Setting**: Cocsit College, Latur, Maharashtra.
- **Sampling method**: Simple random sampling
- **Sample Size:** 110
- **Sample formula** = $\frac{(Z_a+Z_b)^2\times 2\times (SD)^2}{d^2}$

Descriptive statistics:

The study included a total of 110 participants, divided equally with 55 individuals in Group A and 55 individuals in Group B.

The mean age of the patients in Group A was 20.78 ± 2.08 years.
The mean age of the patients in Group B was 20.61 ± 2.28 years.

Physical Fitness Index (PFI) Scores
The Physical Fitness Index was recorded at three different intervals: baseline (1 minute), 3 minutes, and 5 minutes.

Group A: * The mean physical fitness index score at 1 minute was 132.03 ± 18.70.
At 3 minutes, the mean score was 122.69 ± 7.90.
At 5 minutes, the mean score was 112.90 ± 8.26.

Group B: * The mean physical fitness index score at 1 minute was 129.50 ± 12.74.
At 3 minutes, the mean score was 118.74 ± 14.21.
At 5 minutes, the mean score was 110.76 ± 13.85.

Qualitative PFI Rating Distribution
The participants were further categorized based on their overall PFI Rating Score into Poor, Fair, Good, and Excellent categories.

Group A: Within this group, 38.18% of patients had a poor rating, 29.09% had a fair rating, 27.27% had a good rating, and 5.45% achieved an excellent rating.
Group B: Within this group, 69.09% of patients had a poor rating, 27.27% had a fair rating, 3.64% had a good rating, and 0% achieved an excellent rating.
Statistical Software

Procedure:

Ethical clearance was taken, and study was designed to explore the study of physical fitness index using modified Harvard step test in IT students.
As IT students from Cocsit College , 55 males and 55females between 17 and 24 years were used.
All subjects were familiarised with modified Harvard step test.
The procedure of this method is that subject took rest for 5 minutes prior to test and then resting pulse rate was recorded by palpating the radial artery manually. Thereafter, they were asked to perform the stepping exercise.[8]

The subjects were made to perform modified Harvard step test in a rhythmic manner for five minutes, or until exhaustion.[6]

The Subject was advised to step up on the modified Harvard steps of 33cms height once every two seconds (30 per minute) for 5 minutes, a total of 150 steps.
At one, three and five minutes during the test, pulse rate was recorded as :
(a) P1 (Pulse Rate 1) – 1 min after exercise
(b)P2 (Pulse Rate 2) – 3 min after exercise.
(c)P3 (Pulse Rate 3) – 5 min after exercise.[1]

Physical Fitness Index (PFI)
PFI was calculated using the formula:

$$\text{Physical Fitness Index} = \frac{\text{Duration of exercise in seconds} \times 100}{(P1+P2+P3)}$$

Where P1, P2 and P3 being pulse rates one minute, three minutes and five minutes after exercise respectively.[12]

After taking permission from institutional ethical committee

Table 1: Physical Fitness Index Rating[13]

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

Result:

Table 1: Comparison of mean age in two groups

Group	N	Mean	Std. Deviation	Std. Error Mean	t-value
Group A	55	20.78	2.08	0.28	0.39, p=0.69,NS
Group B	55	20.61	2.28	0.30	

Mean age in years of patients of group A was 20.78±2.08 and in group B it was 20.61±2.28. By using Student's unpaired t test statistically no significant difference was found in the patients hhof two groups (t=0.39,p=0.69),

Graph 1: Comparison of mean age in two groups

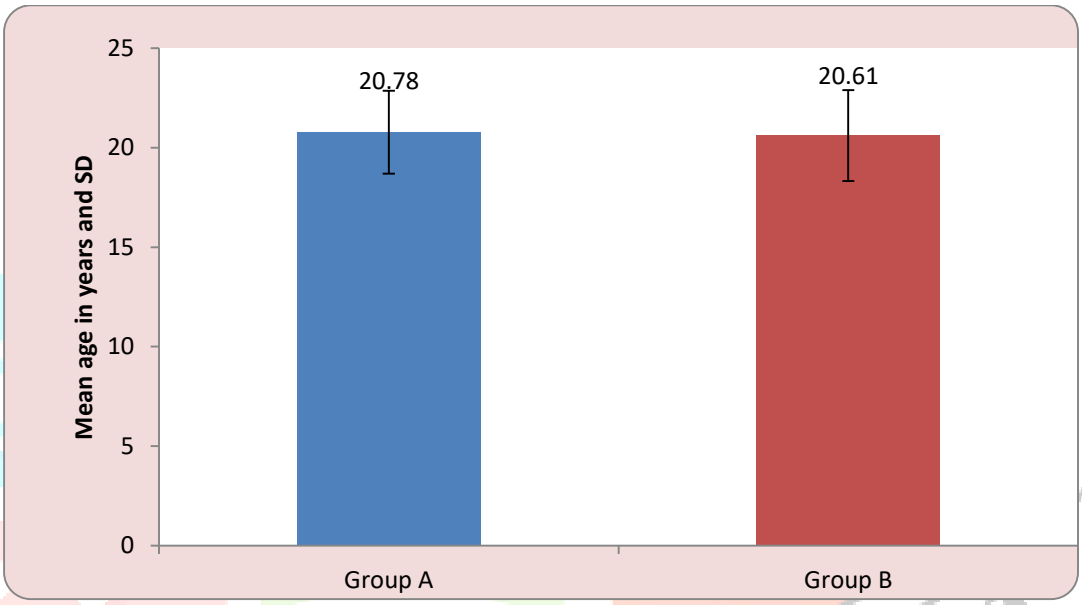


Table 2: Comparison of Physical Fitness Index Score in group A at 3minute, 5 minute compared with Baseline (1 minute)

Student's Paired t test

	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	t-value
1 minute	132.03	55	18.70	2.52	-	-
3 minutes	122.69	55	7.90	1.06	9.34±17.80	3.89 P=0.0001,S
5 minutes	112.90	55	8.26	1.11	19.12±18.68	7.59 P=0.0001,S

Mean physical fitness index score at 1minute is 132.03±18.70, at 3 minutes it is 122.69±7.90 and at 5 minutes it is 112.90±8.26. By using Student's paired t test statistically significant difference was found in physical fitness index score at 3 minutes(t=3.89, p-value=0.0001) and at 5 minutes(t=7.59,p-value=0.0001).

Graph 2: Comparison of Physical Fitness Index Score in group A at 3-minute, 5 minute compared with Baseline (1 minute)

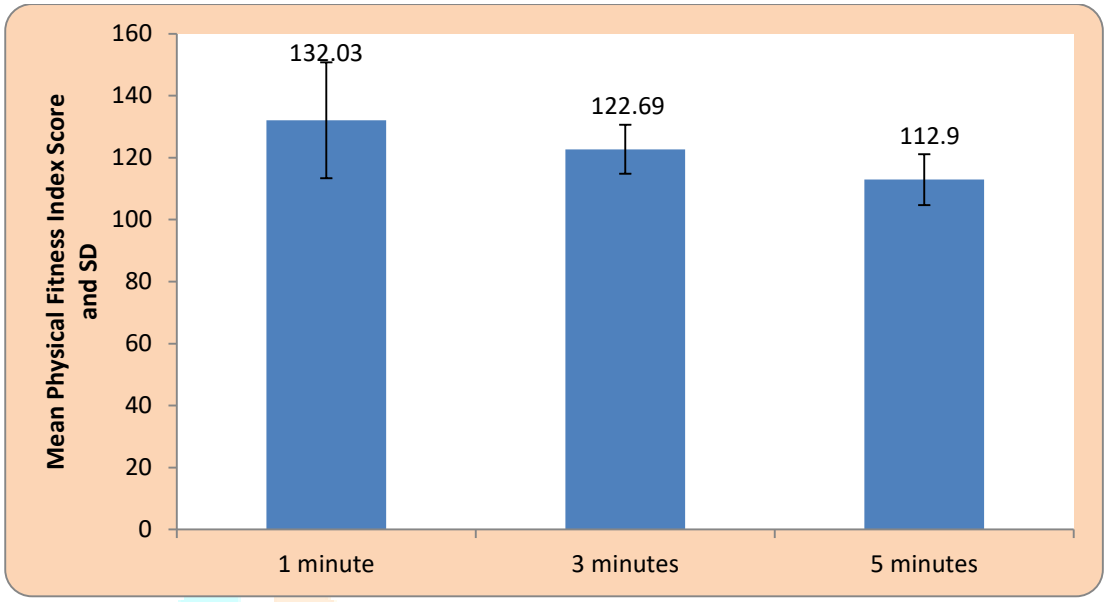


Table 3: Comparison of Physical Fitness Index Score in group B at 3 minute, 5 minute compared with Baseline(1 minute)

Student's Paired t test

	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	t-value
1 minute	129.50	55	12.74	1.71	-	-
3 minutes	118.74	55	14.21	1.91	10.76±3.79	21.03 P=0.0001,S
5 minutes	110.76	55	13.85	1.86	18.74±5.74	24.18 P=0.0001,S

Mean physical fitness index score at 1minute is 129.50±12.74, at 3 minutes it is 118.74±14.21 and at 5 minutes it is 110.76±13.85. By using Student's paired t test statistically significant difference was found in physical fitness index score at 3 minutes(t=21.03, p-value=0.0001) and at 5 minutes(t=24.18,p-value=0.0001).

Graph 3: Comparison of Physical Fitness Index Score in group B at 3 minute, 5 minute compared with Baseline(1 minute)

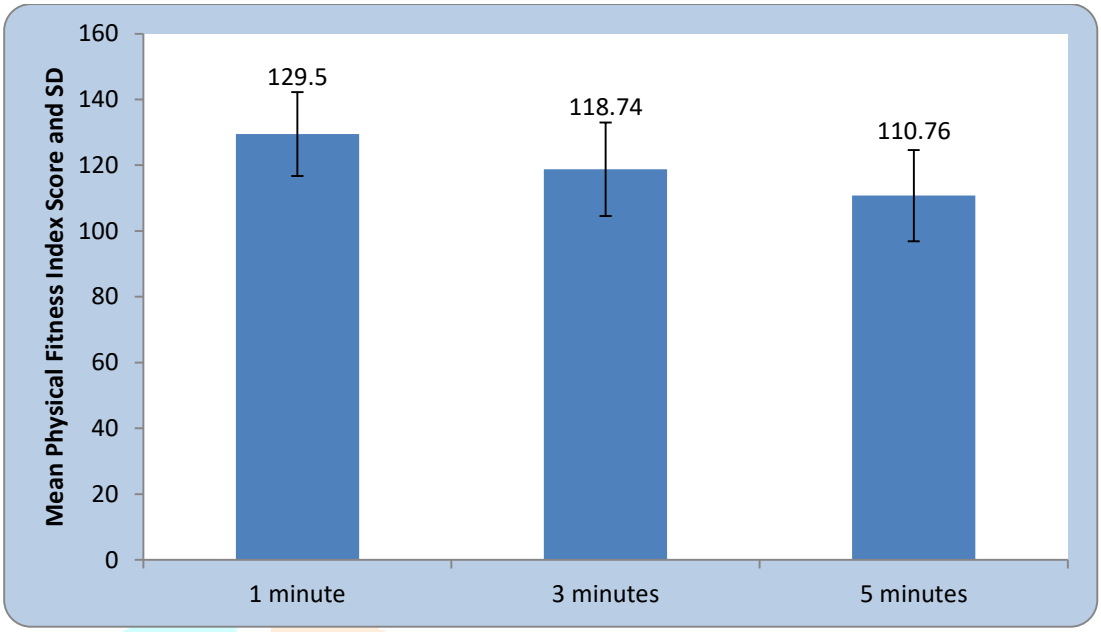


Table 4: Comparison of Physical Fitness Index Score in two groups at 1 minute, 3 minute, 5 minutes

Student's Unpaired t test

	Group A		Group B		t-value	p-value
	Mean	SD	Mean	SD		
1 minute	132.03	18.70	129.50	12.74	0.82	0.40,NS
3 minutes	122.69	7.90	118.74	14.21	1.79	0.07,NS
5 minutes	112.90	8.26	110.76	13.85	0.98	0.32,NS

Mean physical fitness index score at 1 minute in group A is 132.03±18.70 and in group B it is 129.50±12.74. By using Student's unpaired t test statistically no significant difference was found in physical fitness index score at 1 minute(t=0.82, p-value=0.40).

Mean physical fitness index score at 3 minutes in group A is 122.69±7.90 and in group B it is 118.74±14.21. By using Student's unpaired t test statistically no significant difference was found in physical fitness index score at 1 minute(t=1.79, p-value=0.07).

Mean physical fitness index score at 5 minutes in group A is 112.90±8.26 and in group B it is 110.76±13.85. By using Student's unpaired t test statistically no significant difference was found in physical fitness index score at 1 minute(t=0.98, p-value=0.32).

Graph 4: Comparison of Physical Fitness Index Score in two groups at 1 minute, 3 minute, 5 minutes

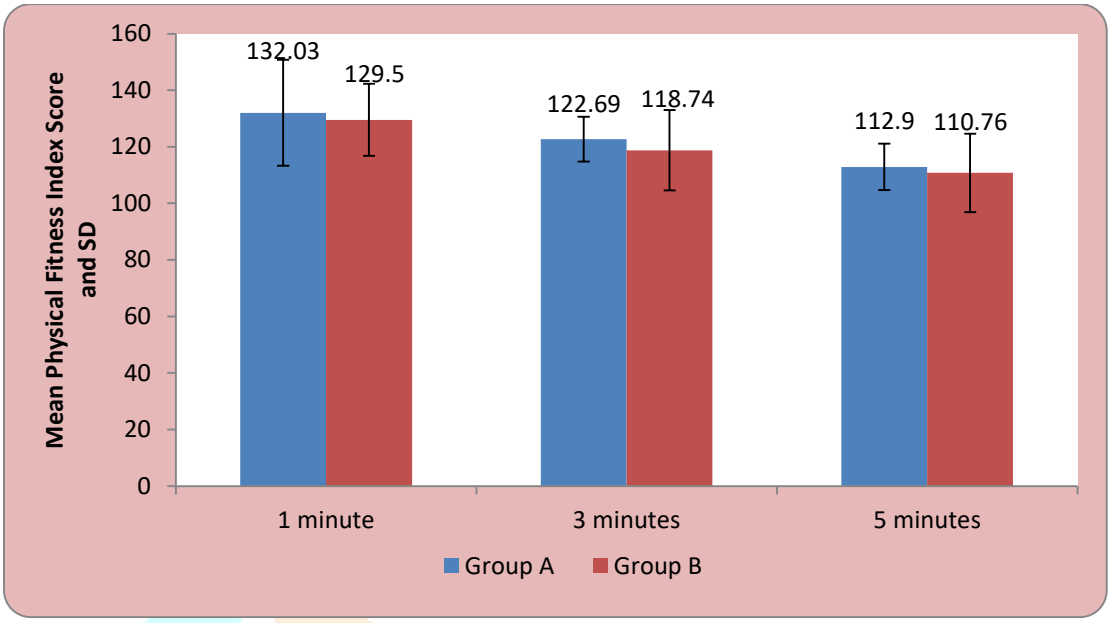


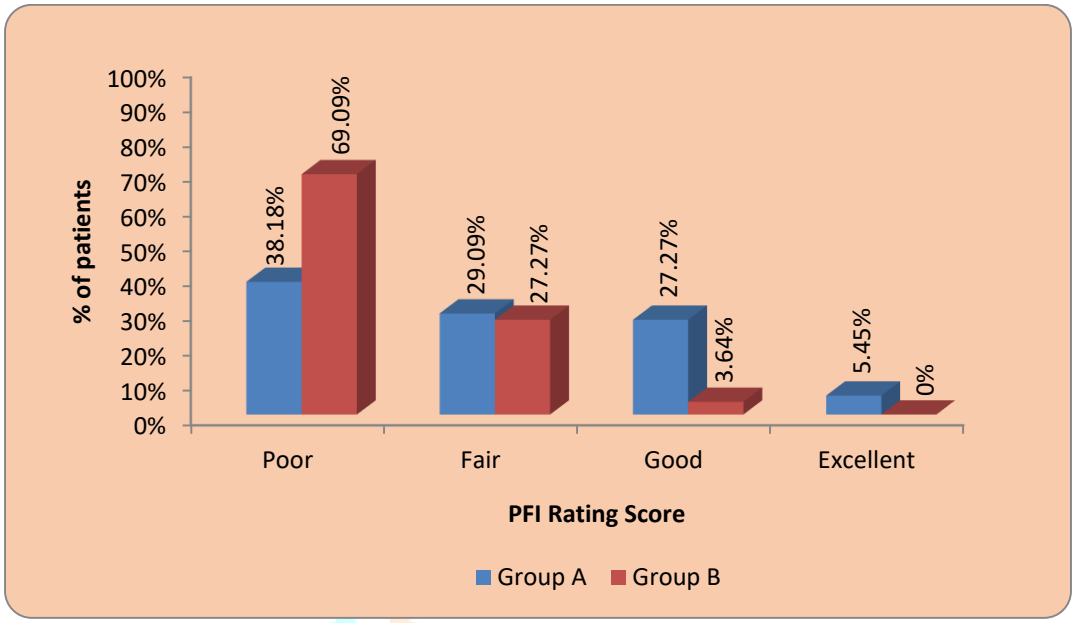
Table 5: Comparison of PFI Rating Score in two groups

Chi square Test

PFI rating score	Group A	Group B	⨪2-value	p-value
Poor	21(38.18%)	38(69.09%)	17.87	0.0005,S
Fair	16(29.09%)	15(27.27%)		
Good	15(27.27%)	2(3.64%)		
Excellent	3(5.45%)	0(0%)		
Total	55(100%)	55(100%)		

38.18% of patients in group A and 69.09% in group B had poor PFI rating score, 29.09% in group A and 27.27% in group B had fair PFI rating score, 27.27% in group A and 3.64% of the patients in group B had good PFI rating score and 5.45% of the patients in group A had excellent level of PFI rating score. By using chi-square test statistically significant difference was found in PFI rating score among patients of two groups (⨪2-value=17.87, p-value=0.0001).

Graph 5: Comparison of PFI Rating Score in two groups



Statistical analysis was done by using descriptive and inferential statistics using Chi-square test, Student's paired and unpaired t test and software used in the analysis were SPSS 27.0 version and GraphPad Prism 7.0 version and $p<0.05$ is considered as level of significance.

Discussion

The present study aimed to evaluate and compare the Physical Fitness Index (PFI) among male and female IT students using the Modified Harvard Step Test. Physical fitness is an important indicator of cardiovascular efficiency and the ability of the body to perform daily activities without undue fatigue. According to C. J. Caspersen and colleagues, physical fitness reflects the capacity to perform physical activity and is influenced by factors such as lifestyle, habitual activity levels, and physiological characteristics. The findings of the present study revealed that the majority of participants in both groups demonstrated relatively low physical fitness levels, with a large proportion of students falling into the "poor" fitness category.

In the female group (Group A), out of 55 participants, most students were categorized under poor fitness levels, while a smaller number were classified as fair, good, or excellent. Although a few female students demonstrated good or excellent PFI scores, the overall distribution suggested that many female IT students possess limited cardiovascular endurance. The highest PFI score recorded in the female group was 96.1, indicating excellent cardiovascular fitness in a small subset of participants, while the lowest value was approximately 70.1, indicating poor fitness. These findings suggest variability in fitness levels among female students, which may be influenced by differences in lifestyle habits, participation in physical activity, and individual health status

Similarly, the results obtained from the male group (Group B) showed that the majority of male students were also categorized under the poor fitness level, with fewer students falling into the fair and good categories. The highest PFI score among males was 107.6, indicating good cardiovascular endurance in certain individuals, whereas the lowest value was 63.8, indicating poor fitness. Although male participants demonstrated slightly higher maximum PFI scores compared to females, the overall trend still indicated that most male IT students had suboptimal fitness levels. This suggests that despite potential physiological advantages, such as greater muscle mass and higher hemoglobin levels, male students may still experience reduced physical fitness due to sedentary lifestyles and insufficient physical activity.

When comparing both groups, it was observed that the distribution of physical fitness levels was generally similar, with a large number of participants in both groups falling under the poor category. However, female students showed a slightly more balanced distribution across the fair, good, and excellent categories, whereas male students were more concentrated within the poor category. Despite this, male students showed higher peak PFI scores in some cases, which could reflect differences in physiological capacity or occasional participation in physical activities. Gender-related differences in physical fitness have been documented in previous research by A. W. Sloan, who reported that males generally exhibit greater aerobic capacity and work capacity compared to females due to biological and hormonal factors.

The Modified Harvard Step Test used in the present study is widely recognized as a reliable method for assessing cardiovascular fitness. Research by Ivar Ryhming demonstrated that the Harvard Step Test provides a simple and effective measure of physical work capacity and recovery ability. The PFI derived from this test reflects the efficiency of the cardiovascular system in recovering from physical exertion. Higher PFI scores indicate faster recovery rates and better cardiovascular endurance, while lower scores suggest reduced fitness and slower recovery.

The overall low PFI scores observed in the present study may be attributed to the sedentary lifestyle commonly associated with IT students. IT students typically spend extended hours working on computers, attending online lectures, or completing academic tasks, which significantly reduces their opportunities for physical activity. Prolonged sitting and minimal physical movement can lead to decreased cardiovascular endurance and reduced physical fitness over time. Similar findings have been reported in studies among medical and physiotherapy students, where academic workload and sedentary study patterns were identified as major contributors to low physical fitness levels.

Another factor contributing to reduced physical fitness among students may be the lack of regular exercise habits. Many students prioritize academic responsibilities over physical activity, leading to irregular or minimal participation in sports and recreational activities. According to Edward Frank and colleagues, a significant proportion of university students do not meet recommended physical activity guidelines, which can negatively affect their overall health and fitness. This lack of physical activity may explain why many participants in the present study demonstrated poor PFI scores.

Additionally, gender-related differences in participation in physical activities may influence the observed results. Previous studies have suggested that females often engage less frequently in vigorous physical activities compared to males due to social, cultural, or environmental factors. Research by Richard M. Telford found that girls and young women tend to participate less in moderate-to-vigorous physical activities, which may contribute to differences in physical fitness levels. However, in the present study, the difference between male and female fitness levels was not very large, suggesting that both groups may share similar lifestyle patterns characterized by limited physical activity.

The findings of the present study are consistent with previous research conducted among student populations. Studies using the Modified Harvard Step Test have reported that many college students demonstrate moderate to poor physical fitness levels due to sedentary behavior and limited engagement in regular exercise. These findings emphasize the importance of promoting physical activity programs and fitness awareness among university students to improve their cardiovascular health and overall well-being.

The results of this study highlight the need for increased emphasis on physical activity among IT students. Educational institutions should encourage participation in sports, fitness programs, and recreational activities to improve students' physical fitness levels. Incorporating regular exercise into daily routines may help improve cardiovascular endurance, reduce stress, and enhance overall health.

Despite providing useful insights, the present study has certain limitations. The sample size was limited to IT students from a specific population, and therefore the findings may not be generalizable to all student populations. Additionally, factors such as body mass index, dietary habits, and lifestyle behavior were not assessed, which may also influence physical fitness levels.

Overall, the findings of the present study suggest that a large proportion of both male and female IT students exhibit poor physical fitness levels. This highlights the need for targeted interventions aimed at increasing physical activity and promoting healthier lifestyles among students in order to improve their cardiovascular fitness and long-term health outcomes.

CONCLUSION:

These results suggest that sedentary lifestyle habits, prolonged sitting hours, and limited physical activity commonly seen among IT students may contribute to reduced physical fitness levels. The Modified Harvard Step Test proved to be a simple, practical, and effective method for assessing cardiovascular fitness in young adults.

Therefore, it is important to encourage regular physical activity, fitness awareness, and healthy lifestyle practices among students in order to improve their cardiovascular endurance and overall health

Physical fitness of IT students in Cocsit college is not satisfactory. This may be due to the sedentary life style and lack of sporting activities & also over emphasis on academic pursuits
Females are having better physical fitness as campare to male in IT Students.

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