Physical Fitness among Doctors Working in a Tertiary Care Teaching Hospital

Shivappa GC\(^1\), Revathi Devi ML\(^2\), Manjunatha SN\(^3\)

\(^1\)Assistant Professor, Department of Physiology \(^2\)Professor & Head, Department of Physiology, \(^3\)Associate professor, Department of Community Medicine, MMCRI, Mysuru

Abstract

**Background:** Physical fitness is the capacity to perform a sedentary task efficiently and also a sense of physical wellbeing and the capacity to deal with emergencies demanding unaccustomed physical effort. The fit man carries on a given grade of moderate work with less displacement of his physiological equilibrium.

**Objectives**

1. To measure the Physical Fitness Index of doctors at tertiary care hospital using modified Harvard Step Test.
2. To correlate physical fitness scoring with Body Mass Index, gender and physical activity.

**Method:** A cross sectional study was conducted on 156 doctors working in tertiary care teaching hospital attached to Mysore Medical College and Research Institute during June 2018 to May 2019. Modified Harvard step test was used to measure physical fitness. SPSS 17 version was used for statistical analysis.

**Results:** Males constituted 42.3% and females constituted 57.7% of the study population with a mean age of 33.5 years. BMI of females was little higher (24.01±3.77) when compared to males (24.03±3.01). Forty percent of females had excellent physical fitness whereas only 6.06% of males had excellent physical fitness. Only 14.40% of the female doctors had poor physical fitness whereas 36.36% of males had poor physical fitness. It was found that BMI and pulse rate had a statistically significant negative correlation with physical fitness whereas physical activity, Systolic and diastolic blood pressure had positive correlation.

**Conclusion:** Physical activity is an important determinant and predictor of physical fitness. Females are having better physical fitness as most of them are pursuing some physical activity.

**Key Words:** Modified Harvard Step Test; Physical Fitness Index; Pulse Rate Variability

Introduction

Physical fitness is the capacity to perform a sedentary task efficiently and also a sense of physical wellbeing. It is also a capacity to deal with emergencies demanding unaccustomed physical effort.

The fit man carries on a given grade of moderate work with less displacement of his physiological equilibrium.\(^{10}\) He can establish steady states of higher grades of work. Regular muscular fitness training program improves endurance and flexibility of trunk and lower limb musculature\(^{14}\).

In today’s life there is more stress and less physical activity. Fitness becomes more important both physiologically and psychologically. Fitness is defined as state of mental and physical harmony which enables one to perform his daily activity to the best.
Doctors require absolute physical and mental fitness during their working. The present study is to assess physical fitness among doctors working in a tertiary care teaching hospital.

**Objectives**

1. To measure the Physical Fitness Index of doctors at tertiary care hospital using modified Harvard Step Test.

2. To correlate physical fitness scoring with Body Mass Index, gender and physical exercise.

**Materials and Method**

The study sample consisted of 156 doctors of MMC&RI, 66 male doctors and 90 female doctors. The study was conducted for the period of one year (June 2018 to May 2019) in the Department of Physiology, Mysore Medical College and Research Institute, Mysore.

**Inclusion Criteria**

a. Healthy male and female doctors aged between 25 and 60 years.

**Exclusion Criteria**

a. Doctors with musculoskeletal disability.

b. History of cardiovascular disorders.

**Method of Collection of Data**

All the exercise data were collected during morning hours between 7 am to 9 am to avoid any possible diurnal variation effect. Subjects were told to report an hour before exercise. The details of the procedure of exercise test were explained to the subjects and actually demonstrated before in order to allay apprehension. Written informed consent was obtained from them. They were asked to refrain from eating or drinking at least for an hour and allowed to take rest for half an hour before exercise. Before the exercise test, the physical anthropometric parameters like height, weight and BMI and physiological parameters like pulse rate, respiratory rate and blood pressure of the subjects were recorded.

**Recording of Physical Fitness Index by Using modified Harvard Step Test**

Physical fitness index of each subject was recorded by using modified Harvard step test with step height 40 cms (instead of 50 cms of original HST) for males and 33 cms for females, which is a wooden step, heavily constructed such that it remains steady always during the test (validated). The observer calls the rhythm, at the signal “start” stopwatch is started, metronome is turned on. The subject places one foot on the platform and later the other and immediately steps down, bringing down first the same foot which he placed up first. At exactly 3 seconds intervals the signal ‘up’ is given and rhythm is maintained by giving the following count up, -2-, -3, -4 up, -2, -3, -4. The subject should “lead-off” with the same foot each time and not try to alternate the foot. The subject is exercised at the rate of 20 times (instead of 30 times of original HST) a minute for 5 minutes continuously unless he stops from exhaustion.

All subjects were stopped at 5 minutes if they could go that long. Exhaustion is defined as when the subjects could not maintain the stepping rate for 15 per minute. The subjects who did not complete the duration of test (5 minutes) are not included in the result because it is difficult to assess the fitness.

When the subject successfully completes the test recovery time starts counting. He is made to lie quietly on the cot. Three readings (radial pulse) were taken during this recovery phase. The first reading was from 1 minute to 1 minute 30 seconds after the exercise, the second reading was from 2 minutes to 2 minutes 30 seconds after the exercise and the third reading from 3 minutes to 3 minutes 30 seconds after the exercise.

The Physical Fitness Index is calculated by using following formula.

\[
PFI = \frac{\text{Duration of exercise in seconds x 100}}{2 \times \text{Sum of the three half minute post exercise pulse counts}}
\]

Blood pressure (SBP and DBP) at 3 minute 30 seconds and 4 minutes 30 seconds after the exercise were also recorded in supine position.

According to modified Harvard Step test the following scores are used for classifying the physical fitness of study subjects.

**PFI rating and PFI score**

| PFI Rating | PFI Score Male | PFI Score Female |
|------------|----------------|-----------------|
| Excellent  | >115           | >91             |
| Good       | 103-115        | 84-91           |
| Fair       | 91-102         | 77-83           |
| Poor       | <91            | <77             |
Statistics: Statistical package for Social Science 17 version was used for analyses of the data. Descriptive statistics like mean and SD were used. Chi-square test, student t-test, correlation coefficients were used for the analysis of the data.

Results

Table 1: Profile of study subjects

| Gender | Number (%) | Age (years) (Mean ± SD) | BMI (kg/m2) (Mean ± SD) |
|--------|------------|-------------------------|-------------------------|
| Male   | 66 (42.3)  | 34.88 ± 9.78            | 24.03 ± 3.01            |
| Female | 90 (57.7)  | 32.93 ± 8.22            | 24.01 ± 3.77            |

It was interesting to find a great disparity in the physical fitness levels of males and females. This gender difference was statistically significant.

Table 2: Physical Fitness Index among study subjects

| PFI rating | Male (%) | Female (%) | Total (%) |
|------------|----------|------------|-----------|
| Excellent  | 4(6.06)  | 36 (40)    | 40 (25.6) |
| Good       | 11 (16.67)| 18 (20)    | 29 (18.6) |
| Fair       | 27 (40.91)| 23 (25.60) | 50 (32.1) |
| Poor       | 24 (36.36)| 13 (14.40) | 37 (23.7) |
| Total      | 66 (42.3) | 90 (57.7)  | 156 (100) |

Chi square: 110, df: 6, p<0.0001

The average BMI of females was slightly higher than males. Doctors having poor physical fitness had higher BMI when compared to doctors with better physical fitness. This was true for both males and females. Body mass index was inversely related to physical fitness in the present study.

Table 3: Physical fitness according to Body Mass Index

| PFI rating | BMI (kg/m2) |               |
|------------|-------------|---------------|
|            | Male (Mean ± SD) | Female (Mean ± SD) |
| Excellent  | 23.5±3.7    | 24.03± 3.85   |
| Good       | 23.36±1.75  | 24± 2.77      |
| Fair       | 24.22± 2.81 | 22.83± 3.76   |
| Poor       | 24.21±3.65  | 26.42± 4.77   |

Recovery pulse rate after the exercise is used to assess the physical fitness of an individual in most of the methods as it is influenced by physical exercise. Modified Harvard step method also relies on this parameter for deducing the physical fitness of the individual. The basal pulse rate (before exercise) and pulse rate after the exercise was measured among the study subjects.
Table 4: Pulse rate of study subjects (males & females) before and after the exercise according to physical fitness

| PFI rating | Pulse Rate (beats per minute) in males | t-value | Sig* |
|------------|---------------------------------------|---------|------|
|            | Before Exercise (Mean ± SD)           |         |      |
|            | After Exercise (Mean ± SD)            |         |      |
| Excellent  | 75.5±10.63                            | 2.345   | NS   |
| Good       | 75.5±7.31                             | 3.201   | NS   |
| Fair       | 80±8.08                               | 7.865   | S    |
| Poor       | 80.38±10.69                           | 9.543   | S    |

| * S = Significant; NS = Not significant |

| PFI rating | Pulse Rate (beats per minute) in females | t-value | Sig* |
|------------|------------------------------------------|---------|------|
|            | Before Exercise (Mean ± SD)              |         |      |
|            | After Exercise (Mean ± SD)               |         |      |
| Excellent  | 78.15±7.96                              | 2.214   | NS   |
| Good       | 85.2±7.03                               | 6.987   | S    |
| Fair       | 85.44±9.07                              | 7.543   | S    |
| Poor       | 77.91±7.36                              | 11.152  | S    |

| * S = Significant; NS = Not significant |

The mean change in the pulse rate (before exercise and after exercise) among doctors with excellent physical fitness was only 13 units. The mean difference among subjects with poor physical fitness was 46 units. This clearly shows that heart rate variability is least among people with excellent physical fitness. This difference of pulse rate among various groups was found to be statistically significant.

The physical activity, BMI, pulse rate & BP are correlated with physical fitness. Physical activity of study subjects was measured in three grades. Grade ‘0’ meant sedentary life style without any physical exercise other than routine work. Grade ‘1’ meant physical exercise at least 30 minutes a day, 5 days a week e.g. walking, yoga, etc. Grade ‘2’ meant participation in sports, athletics, gym, etc.

Table 5: Correlation of physical fitness with BMI and physical activity and cardiovascular variables

| PFI score | BMI | Physical activity scores | Pulse rate | SBP | DBP |
|-----------|-----|--------------------------|------------|-----|-----|
| 1         |     |                          |            |     |     |
| BMI       | 0.76| 1                        |            |     |     |
|          | 0.21| 0.89*                    | 1          |     |     |
|          | 0.73| 0.43                     | 0.91*      | 0.94*| 1   |
|          | 0.79| 0.29                     | 0.51       | 0.34| 0.86*| 1   |

* Significant at 5%


Discussion

Modified Harvard Step Test is proven to be a suitable method for assessing physical fitness of Indians. Many authors have demonstrated the utility of this method in Indian subjects.

This method was adopted by Sunil KR Das, Mahapatra S, Bhattacharya G, Mukherjee D13, in the year 1993 at Laboratory of Human Performance Assessment, Department of Physiology, University College of Science and Technology, Calcutta.

Ganeriwal SK, Sen SL, Khandare SS8 in the year 1968 performed the HST in Indian 51 female medical college students in the age group of 17 to 25 years using a stepping height of 18 inches. Banerjee PK and Chatterjee S3 in the year 1983 studied the effectiveness of the Harvard step test in assessing the physical fitness in 54 Indian adolescent boys.

The present study showed that 40% female subjects had excellent physical fitness and 14.40 had poor physical fitness.

Das SK, Nath N, Ray A6, in the year 1990 studied the PFI using Astride Jump Test as an alternative of Harvard Step Test in 218 school girls having age 12 to 16 years in suburban area of Calcutta. In which 19% girls had excellent and 16% had poor physical fitness. Shivappa GC, Revathidevi ML, Manjunatha SN12 in the year 2012 studied the physical fitness in the 365 medical students having age 17 to 22 years in a government medical of Karnataka by modified Harvard Step Test. In which 46% girls had excellent and 6% had poor physical fitness.

In our study 6.06% of the male subjects had excellent physical fitness and whereas 36.36% had poor physical fitness.

Das SK, Adhikari A, Goshtakur5, in the year 1988 studied the PFI using Harvard Step Test in 134 athletic boys having age ranging from 12 to 15 years belonged to various training camps in and around Calcutta. In which only 3% of male subjects had excellent and 23% had poor physical fitness.

Shivappa GC, Revathidevi ML, Manjunatha SN12 in the year 2012 studied the physical fitness in the 365 medical students having age 17 to 22 years in a government medical of Karnataka by modified Harvard Step Test. In which 5.7% male subjects had excellent and 44% had poor physical fitness.

It was found that 50 percent of male & 45 percent of females studied had grade ‘1’ & ‘2’ physical activity. This study has clearly established that physical activity is important determinant and predictor of physical fitness.

There are no sufficient studies to compare PFI rating among males and females.

The average BMI of males was found to be $24.03 \pm 3.01 \text{kg/sq m}$ and the average BMI of females was found to be $24.01 \pm 3.77 \text{kg/sq m}$. It was found that BMI was inversely proportion to physical fitness both among males and females.

The present study is consistent with the study by Ganeriwal SK, Sen SC and Khandare(1968)8, in which there was negative correlation between fitness index and body weight, pulse rate and positive correlation between fitness index and body height.

The present study is consistent with the study by Shivappa GC, Revathidevi ML, Manjunatha SN12, in which there was negative correlation between fitness index and body weight, pulse rate and positive correlation between fitness index and body height.

Pulse rate variability (pre and post exercise) was minimum among subjects who had excellent physical fitness and it was maximum among subjects who had poor physical fitness index.

The present study is consistent with the study by Hammond(1987)9, which says that endurance athletes have lower resting and exercise heart rates which may be in part relate to down regulation of cardiac beta-adrenergic receptors secondary to repeated and prolonged episodes of sympathetic stimulation during exercise.

Systolic and diastolic blood pressure variabilities (pre and post exercise) were minimum in all the groups of physical fitness.

The present study is consistent with the study by Dalia A Biswas and Jayanth R Kher(1996)4, reported that heart rate, systolic blood pressure, double product and respiratory rate rose linearly with increasing grades of exercise while diastolic blood pressure recorded a fall.

Physical fitness was correlated with BMI, physical activity, gender and cardiovascular variables. Physical fitness had a statistically significant negative correlation with BMI.
The present study agrees with the study by Anabel NR, Anselmo JP, et al. (2007)\(^2\) which reported that the faster heart rate was observed in the group with lower physical fitness (male and female). Additionally it is known that overweight and obese individuals exhibit lower levels of physical fitness.

In the present study subjects who had regular physical activity had better physical fitness and two variables were positively correlated.

The present study agrees with the study by Dipayan C, Soma C, et al. (2002)\(^7\) which showed that non-residential school children who did not have regular physical activity showed a less physical fitness index scores as compared to residential school children were engaged in regular physical activity.

In the present study females had better physical fitness as majority of them are pursuing physically active lifestyle though the study had established a strong positive correlation between physical fitness and female gender. It may be due to the confounding by physical activity.

Pulse rate had a statistically significant negative correlation with the physical fitness and also physical activity in our study.

The present study agrees with the study by Albert W (1971)\(^1\) who reported that a lower arterial blood pressure and bradycardia are two prominent characteristics brought about by training.

**Conclusion**

1. Physical fitness of doctors working in a tertiary care teaching hospital attached to Mysore Medical College and Research Institute, Mysore is not satisfactory. This may be due to the sedentary life style and lack of sporting activities and also over emphasis on hospital work.

2. Females are having better physical fitness as most of them are pursuing some physical activity.

3. Regular physical activity is an important determinant of physical fitness.

4. Overweight and obesity decreases the physical fitness of individuals.

5. Heart rate variability is less among physically fit individuals during physical exercise.

**Ethical Clearance**- Taken from institutional committee, MMCRI, Mysore.

**Source of Funding**- Self

**Conflict of Interest**- Nil

**References**

1. Albert W. A physiological analysis of the effects of two training programmes. J Sports Med 1971;11:252-6.

2. Anabel N R, Anselmo JP, Luciana C, Nazare S B. The association between cardio- respiratory fitness and cardiovascular risk in adolescents. J Paediatrics (Rioj) 2007;83(5):1-12

3. Banerjee PK and Chatterjee S. Harvard Step Test as a measure of physical fitness in adolescent boys. Indian J Med Res 1983;79:413-7.

4. Dalia AB and Jayant RK. Cardio-respiratory changes associated with graded exercise and determination of aerobic power in male medical students. Indian J Physiol and Pharmacol 1996;40(1):79-82.

5. Das SK, Adhikari A and Gosthakur D. Gradation of Harvard Step Test scores in athletic boys. Indian J Physiol and Allied Science 1988;42(1):8-10.

6. Das SK, Nath N, Ray A. Studies of physical fitness index (PFI) in school girls. Indian J Physiol and Allied Science 1990;44(1):4-6.

7. Dipayan C, Soma C, Vasantha AK. Physical fitness and non-residential schools. Indian J Physiol and Pharmacology 2002;46(3):328-32

8. Ganeriwal SK, Sen SC and Khandare SS. Test of physical fitness (Harvard Step Test) in Indian females. Indian J Med Res 1968;56:845-9.

9. Hammond. Association of decreased myocardial beta-receptors and chronotrophic response to isoproterenol and exercise in pig following chronic dynamic exercise. Circulation Research 1987;60:720-6.

10. Johnson RE. Applied physiology. Am Rev Physiol 1946;81:585.

11. Rhyming I. A modified Harvard Step Test for evaluation of physical fitness. Arbeistphysiologie, Bd 1954;15 S:235-250.

12. Shivappa GC, Revathidevi ML, Manjunatha SN. A study of physical fitness among the students in a government medical college of Karnataka by modified Harvard Step Test. Indian J physiol and
13. Sunil KR Das, Mahapatra S, Bhattacharya G and Mukherjee D. Determination of Physical Fitness Index (PFI) with modified Harvard Step Test (HST) in young men and women. Indian J Physiol and Allied Science 1993;47(2):73-6.

14. Swetha Satish DP, Sumaiya AK, Rauf I and Rmkrishna KS. Assessment of endurance, power and flexibility of navi Mumbai traffic police: Int J Med Pharm Sci, July 2014;4(11):20-25.