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Physical Fitness Index and Body Parameters in Medical Students.

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Abstract:

Physical fitness implies not only the absence of disabling deformity of 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. There is a need to know the physical fitness levels of our future doctors. They can be sensitised to pursue a healthy life style right from the begining of their medical career. The present study was undertaken to assess the physical fitness index using modified Harvard Step Test.

Present Cross Sectional Observational Study was conducted in Department of physiology, MGM Medical College and Hospital, Aurangabad [MH], India in Medical Students of 1st MBBS. The physical fitness of 192 male and 173 female medical students was evaluted using modified Harvard Step method 25.2% of study subject had excellent physical fitness. It was found that females had better fitness when compared to males. It was found that BMI had a statistically significant negative correlation with physical fitness, which means as BMI increases physical fitness decreases. Physical activity scores had a statistically significant positive correlation with physical fitness. Gender was also found to be correlated with physical fitness. In the present study, females had higher physical fitness than their male counterparts and this difference was statistically highly significant. Pulse rate was found to have a negative correlation with physical fitness. Systolic and diastolic blood pressure had statistically significant positive correlation with physical fitness.

Keywords: Physical Fitness, Physical Efforts, Medical Students.

Introduction:

Physical fitness implies not only the absence of disabling deformity of 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.

Fitness is a relative term. An individual is considered to be fit for a perticular task or activity when he can accomplish it with areasonable degree of efficiency, without undue fatigue and with rapid recovery from the effects of exertion. Most type of stress requires varying degree of anatomical, physiological and phycological fitness. Anatomical fitness implies possession of all the parts and organs of the body which are essential to the performance of thetask. Physiological fitness implies the capasity for skilful performance and rapid recovery. Phycological fitness for a task implies that the subject possesses the necessary emotional stability, drive or motivation, intilligence and educability.

The fit man carries on a given grade of moderate work with less displacement of his physiological equilibrium.[1] He can establish steady states of higher grades of work.

Fitness or training are the most misused and overused words in english language. Sri Roger Bannister defined the physical fitness "as a state of mental and physical harmony which enable some one to carry on his occuptionto the best of his ability with the greatest happiness". Prof. Asmussen mentioned that fitness for sports and work has both an absolute relative meaning.

Cardiac output , pulmonary ventilation, oxygen consumption,carbon dioxide output and heart rate during and after exercise are so closely interrelated in an individual performing a standerd bout of work that fairly accurate estimates of all other factors can be made from the measured value of single factor. Post exercise heart rate is frequently used because of the ease and convenience of his measurement.[2]

The exercise employed in the physical fitness tests place the systems of the body (particularly the cardiovascular system) under stress. Running on a trademill, peadalling a stationary bical and stepping up on to a stool are frequently used because they involve large muscle groups in fair work but do not demand unusual skills. Performance is measured by the maximal duration of the effort or by the maximal

amount of work accomplished. Physiological effect is estimated from the magnitude of the heart rate to normal following the exercise.

There is a need to know the physical fitness levels of our future doctors. They can be sensitised to pursue a healthy life style right from the begining of their medical career.

The physical fitness index measures the physical fitness for muscular work and the ability to recover from the work. The present study was undertaken to assess the physical fitness index using modified Harvard Step Test in young adults in the age group of 17 to 22 years with varying degree of physical activity.

Aim and Objectives:

The objectives of this study are as follows.

1. To measure the Physical Fitness Index of medical students using modified Harvard Step Test.
2. To correlate physical fitness scoring with Body Mass Index, gender and physical exercise.

Material & Methodology:

Study Setting: Department of physiology, MGM'S Medical College and Hospital, Aurangabad.

Study Design : Cross Sectional Observational Study

Study Period: May 2012 to December 2014.

Study Subjects:

(i) Sample: Medical Students of 1st MBBS MGM'S MC Aurangabad.

(ii) Sample Size: A total of 365 medical students, 192 male students and 173 female stusents.

Inclusion criteria:

a. Healthy young male and female students.
b. Aged between 17 and 22 years.

Exclusion criteria:

a. Students with locomotor and musculoskeltal disability.
b. History of cardiovascular disorders.
c. History of diabetes mellitus, hypertension, bronchial asthma.
d. History of major surgery in the recent past.
e. History of drug intake.
f. History of alcohol and smoking.

Pilot Study: Pilot study was done with 25 students using modified Harvard Step Test.

Instruments:

Physical fitness index of study subjects was assessed using modified Harvard Step Test which includes the following instruments.

1. Modified Harvard Step bench: It is used for Harvard Step exercise testing.
2. Stop watch: It is used to record the timing in seconds during the procedure.
3. Sphygmomanometer: It is an instrument use to record the blood pressure.
4. Stethoscope: It is used for recording the blood pressure by auscultatory method.
5. Metronome: It is used to adjust the frequency of steps.

This instrument is used in experiments requiring an interruptor adjusted from 40 to 200 contacts/min. The frequency of interruption is adjusted by sliding the clip on a side ways movable metal plate in front of a graduate scale. The posiotion of the clip on the scale gives the frequency at which the sound is delivered. The following is the scoring pattern used in this study.

Table 1: PFI rating according to modified Harvard Step Test 85

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

The physical fitness scoring are different in males and females. Physical fitness is having four grades i.e. excellent, good, fair and poor. Accordong to this method, the range for males is >115 to <91 and for females >91 to <77.

Method of collection of data:

All the exercise data were collected during morning hours between 9 am to 11 am to avoid possible diurnal variation effect. Subjects were told to report an hour before exercise. The details of the procedure of exercose test were explained to the subjects and actually demonstrated before, in order to allay apprehension. 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 anthropometric and physiological parameters of the subjects were redorded. All the data were recorded in the proforma for each subject. The recordings of the physical fitness parameters were made.

Observation & Results:

Table 2: Profile of study subjects

Gender	Number (%)	Age (Year) (Mean±SD)	BMI(Kg/M2) (Mean±SD)
Male	192(52.6)	19.4±1.24	20.9±3.02
Female	173(47.4)	19.5± 1.06	21.7±3.09

Males constituted 52.6% and female's costituted 47.4%. Mean age of study subjects was around 19.5 years. Body mass index of females was little higher (21.7) when compared to males (20.9).

Table3: Physical Fitness Index among study subjects

Gender	Male (%)	Female (%)	Total (%)	Chi-square value	p-value
Excellent	11(5.7%)	81(46.8%)	92(25.2%)	110	P<0.0001 S
Good	33(17.2%)	32(18.5%)	65(17.8%)		
Fair	62(32.3%)	48(27.7%)	110(30.1%)		
Poor	86(44.8%)	12(6.9%)	98(26.8%)		
Total	192(100%)	173(100%)	365(100%)		

The physical fitness of 192 male and 173 female medical students was evaluted using modified Harvard Step method 25.2% of study subject had excellent physical fitness. It was found that females had better fitness when compared to males. 46% of female subjects had excellent physical fitness whereas only 5.7% of males had exellant physical fitness. 17% of study subject had good physical fitness. 30.0% belonged to fair fitness category. 26.0% of study subjects had poor fitness. Only 6% of the females studied had poor physical fitness, whereas 44% of male study subjects had poor physical fitness.

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

Table 4: Body Mass Index of study subjects

PFI rating	BMI(kg/m^2)	
	Male (Mean±SD)	Female (Mean±SD)
Excellent	20.1±2.38	20.40±2.12
Good	20.4±2.91	21.50±2.68
Fair	21.5±3.81	22.00±2.75
Poor	21.6±3.62	22.00±4.82

The average BMI of females was higher than males. Students having poor physical fitness had higher BMI when compared to students 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 5: Pulse rate of study subjects before and after the exercise according to physical fitness.

PFI rating	Pulse Rate (beats/min)		t-value	Significant
	Before Exercise (Mean±SD)	After Excercise (Mean±SD)		
Excellent	74.3±8.16	89.3±7.31	3.85	P<0.0001S
Good	81.3±7.62	100.6±7.31	4.11	P<0.0001S
Fair	83.9±6.83	113.6±4.05	4.89	P<0.0001S
Poor	85.6±8.46	130.5±7.38	7.49	P<0.0001S

S=Significant; NS = Not significant

Pulse rate is an important cardiovascular variable, which is influenced by physical exercise. Pulse rate recovery after the exercise is used to asses the physical fitness of an individual in most of the methods. 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 subject. The pattern of pulse rate variability according to physical fitness is tabulated above.

The mean change in the pulse rate (before exercise and after exercise) among students with excellent physical fitness was only 15 units. The mean difference among subjects with poor physical fitness was 45 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.

Table 6: Systolic blood pressure of study subjects before and after exercise according to physical fitness.

PFI rating	SBP (mmHg)		t-value	Significant
	Before exercise (Mean ±SD)	After Exercise (Mean ± SD)		
Excellent	111.9±7.86	113.9±9.02	0.59	P=0.278NS
Good	109.8±11.23	112±9.71	1.29	P=0.098NS
Fair	114.1±9.52	115.9±9.46	0.76	P=0.233NS
Poor	115±12.86	116.4±11.51	0.64	P=0.261NS

S-Significant; NS Not significant

Systolic blood pressure is another important cardiovascular variable which is influeced by physical exercise. Baseline (pre-exercise) and post exercise systolic blood pressure was measured among the study subjects. The pattern of change among students having different physical fitness was noted. There was no statistically significant difference among all the groups. However, the baseline systolic blood pressure was slightly higher (115 mmHg) among subjects with poor physical fitness when compared to subjects with excellent physical fitness (111mmHg).

Table 7: DBP of study subjects before and after exercise according to physical fitness.

PFI rating	SBP (mmHg)		t-value	Significant
	Before exercise (Mean ±SD)	After Exercise (Mean ± SD)		
Excellent	71.4±6.74	70.4±6.38	0.33	P=0.370 NS
Good	71.8±7.27	68.8±6.14	0.67	P=0.252 NS
Fair	73.9±7.33	71.9±6.58	0.85	P=0.197 NS
Poor	74.1±8.74	69.4±9.12	0.99	P=0.161 NS

S= Significant; NS= Not significant

Diastolic blood pressure is also another important cardiovascular variable which is influenced by physical exercise. Baseline (before exercise) and post exercise diastolic blood pressure was measured among the study subjects. The pattern of change among study subjects having four physical fitness groups was noted. There was no statistically significant difference among four groups. However, the baseline diastolic blood pressure was slightly higher (75 mmHg) among subjects with poor physical fitness when compared to subjects with excellent physical fitness (71 mmHg). The DBP decreased after the exercise in all the fitness groups.

Table 8 : Correlation of physical fitness with BMI, gender and physical activity and cardiovascular variables.

	BMI	Physical Activity Score	Gender	Pulse Rate	SBP	DBP
PFI score	-0.62*	0.49*	0.89*	-0.71*	0.61*	0.73*
BMI	-	-0.23	0.31*	-0.03	0.31	-0.32
Physical Activity Score	-	-	0.02	-0.11	0.43*	0.09
Gender	-	-	-	0.15	0.08	0.71
Pulse Rate	-	-	-	-	0.18	0.08
SBP	-	-	-	-	-	0.21

Significant at 5%

Correlation of physical fitness with anthropometry, physical activity. Gender and cardiovascular variable was studied. The anthropometric parameter correlated with physical fitness was BMI. Physical activity of study subjects was measured in three grads. Grade '0' meant sedentary life style without any physical exercise other than routine work. Grade I meant physical exercise at least 30 minutes a day, 5 days a week eg, walking, yoga, etc. Grade 2 meant participation in sports, athletics, gym, etc. The cardiovascular variables like pulse rate, systolic blood pressure, diastolic blood pressure were correlated with physical fitness.

It was found that BMI had a statistically significant negative correlation with physical fitness, which means as BMI increases physical fitness decreases. Physical activity scores had a statistically significant positive correlation with physical fitness. Gender was also found to be correlated with physical fitness. In the present study, females had higher physical fitness than their male counterparts and this difference was statistically highly significant. Pulse rate was found to have a negative correlation with physical

fitness. Systolic and diastolic blood pressure had statistically significant positive correlation with physical fitness.

Discussion:

The present study evaluated the physical fitness of young medicos using modified Harvard step method. This method has four grades of physical fitness based on the scoring obtained after the exercise.

This 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. Simillary this method was adopted by Sunil KR Das et al [3] in the year 1993 at Laboratory of Human Performance Assessment, Department of Physiology, University Colleges of Science and Technology, Calcutta.

365 medical students with a mean age of 19.5 years and mean BMI of 21.31 were evaluated for physical fitness in this study. It is important for future doctors to know their level of present fitness and try to improve on it.

Ganeriwal SK et al [4] 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 et al [5] 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 females are having excellent physical fitness when compared to their male counterparts. 46% of female subjects had excellent physical fitness whereas only 11% of males studied had excellent physical fitness. 44.0% of the males had poor physical fitness whereas only 6% of females had poor physical fitness. It was found that 52% of females studied had grade '2' physical activity (like sports, athletics, gym, etc.) whereas only 33% of males studied had grade '2' physical activity. This study has clearly established that physical activity is an important determinant and predictor of physical fitness.

Table 9 : Comparison of PFI rating in the present study with other studies is illustrated below.

Study	PFI rating							
	Excellent (%)		Good (%)		Fair (%)		Poor (%)	
	Male	Female	Male	Female	Male	Female	Male	Female
Present study	11 (5.7%)	81 (46.8%)	33 (17.2%)	32 (18.5%)	62 (32.3%)	48 (27.8%)	86 (44.8%)	12 (6.9%)
Das SK et al [6]	4(3%)	-	35 (26.1%)	-	63 (47.0%)	-	32 (23.9%)	-
Banerjee PK et al [7]	11 (20.4%)	-	19 (35.2%)	-	18 (33.3%)	-	6 (11.1%)	-
Das SK et al [8]	-	42 (19.3%)	-	45 (20.6%)	-	96 (44%)	-	35 (16%)

There are no sufficient studies to compare PFI rating among males and females. Majority of the study subjects had normal BMI. The average BMI of maleswas found to be 20.9kg/m2 and the average BMI of females was found to be 21.7 kg/m2. The average BMI of females was little higher than the average BMI of males. 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 et al [9] 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 agrees with the study by Jorge Mota et al [10] in which increased BMI was significantly associated with lower cardiorespiratory fitness in girls.

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 study by Hammond [11] which says that endurance athletes have lower resting and exercise heart rates which may be in part relate to down regulation of cardiac B-adrenergic receptors secondary to repeated and prolonged episodes of sympathetic stimulation during exercise.

The present study is also consistent with the study by Ted D Adoms, et al. [12] revealed a decrease in resting heart rate and an increase in R-wave voltage in leads V5 and V6 and significant increase in resting LV end-diastolic dimension and volume following aerobic training program.

Systolic and diastolic blood pressure variability's (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 Jayant R Kher [13] 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 N Rodrigues et al. [14] 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 et al [15] 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.

The present study also agrees with the study by Pansare MS et al. [16] which showed that one month training is sufficient to bring about increase in physical fitness index and pulmonary function test. The present study is consistent with the study by Lt. Col. Gupta KK et al [17] which showed that there was significant improvement in physical fitness score after 34 days of training.

The present study agrees with the study by John S Hanson and William H Nedde [18] which showed that physical training programme of 8 months is necessary to bring about improvement in cardio-respiratory function. In the present study females had better physical fitness as majority of them pursuing physically active lifestyle though the study had established a strong are positive correlation between physical fitness and female gender. It may be due to the confounding by physical activity.

The present study agrees with the study by Uppal AK and Dey RN [19] who demonstrated that there was increase in vital capacity and decrease in resting pulse rate and early recovery after 8 weeks of training in women.

Mc Ardle WD et al. [20] reported that variations in body mass may explain nearly 70% of the differences in VO2 max scores among individuals. This limits interpretation of exercise performance or absolute values for oxygen consumption when comparing individuals who differ in body size or composition in college women. The present study also showed body mass influences physical fitness and indirectly oxygen consumption.

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

The present study agrees with the study by Elbel [21] , Keen and Sloan [22], Cullumbine [23] who reported the negative correlation between fitness index and initial pulse rate.

Pulse rate also had a negative correlation with the physical activity.

The present study agrees with the study by Albert W et al [24], who reported that a lower arterial blood pressure and bradycardia are two prominent characteristics brought about by training.

The present study also agrees with the study by Joshi AR and Pansare MS [25] reported that after 12 weeks of training the resting pulse rate decreased, Harvard Fatigue Index and cardio-pulmonary reserve were increased.

The present study is consistent with the study by Sloan AW et al [26] who reported that 2-4 months of systematic training improves the physical fitness due to decreased recovery pulse rate.

Systolic blood pressure and diastolic blood pressure had statistically significant positive correlation with physical fitness.

The present study is consistent with the study by Bhave et al [27] who reported that blood pressure (SBP and DBP) increased during exercise stress testing including pulse rate and forced expiratory volume.

Conclusion:

In present study Physical fitness of medical students is not satisfactory. This may be due to the sedentary life style and lack of sporting activities and also over emphasis on academic pursuits. Females are having better physical fitness as most of them are pursuing Ssome physical activity. Regular physical activity is an important determinant of physical fitness. Overweight and obesity decreases the physical fitness of individuals. Heart rate variability is less among physically fit individuals during physical exercise.

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