CORRELATION BETWEEN PHYSICAL FITNESS AND BODY MASS INDEX IN ADULT POPULATION

Amita K. Mevada *, Toral Goswami **, Sobha Naik *, J. M. Jadeja****,**

* Tutor, **Assistant Professor, ***Ex. associate professor, **** Professor and Head of Department,
Department of Physiology, B.J.Medical College, Ahmedabad- 380016

Abstracts: **Background:** Physical fitness means the condition of being physically healthy, especially exercises and proper nutrition. It is one of the most important key to achieve any goal and to lead a healthy life. **Aims & objectives**: The aim of the present study was to evaluate relationship between the physical fitness and the body mass index in young adult population of Ahmedabad. **Methods:** A cross-sectional study was done to determine the correlation between the measures of physical fitness index and body mass index. Eighty subjects (37 males and 43 females) of age group 18-25 years participated in the study. Both male and female subjects' Physical Fitness index was measured by modified Harvard Step Test. The Anthropometrical parameters like Height (cm), Weight (Kg), Body Mass index (Kg/m2) were recorded. **Results:** Mean score of Physical Fitness index, Height, Weight and BMI were significantly higher in males as compared to females. The study revealed high prevalence of low fitness among obese subjects and significant correlation between the selected indices of physical fitness index and body mass index. **Conclusion:** The results showed that the physical fitness index of the subjects differed significantly from one another in the various BMI categories, with the subjects of normal weight possessing a higher fitness than the overweight or obese subjects. Fitness index decreased progressively as the BMI increased.

Key Words: Body Mass Index, Physical Fitness Index

Author for correspondence: Amita K. Mevada, Department of Physiology, B.J.Medical College, Ahmedabad-380016.**E Mail**- suthar.amita@ymail.com

Introduction:

Obesity in both children and adults is increasing at an alarming rate in many developed and developing countries. Young adult obesity rates have almost quadrupled in the last 25 years. The number of obese children has tripled in 20 years. 10% of six year olds are obese, rising to 17% of 15 year olds. The WHO refers Obesity as a global epidemic because of rapid increase in the number of overweight and obese individuals in the last 20 years[1]. This drastic rise in obesity also in adults is mainly due to nutritional transition, physical inactivity, shift toward diet rich in saturated fat, sugar and genetic factors[2].

In our country, we are getting acquainted with the modern amenities at a very fast rate. We are neglecting the natural physical activities. Motorized vehicles are more popular now among adults for quicker transport instead of walking or cycling.

Research has shown that obesity can lead to health problems in later life, including arthritis, heart disease and diabetes. One way to help to ensure that these problems do not arise is to improve adult's physical fitness levels by doing regular exercise and bringing about awareness of physical fitness in the general population. There has been a great deal of concern in recent years about the levels of physical fitness of young people.

Determination of Physical Fitness Index (PFI) is one of the important criteria to assess the cardiopulmonary efficiency of a subject[3]. The American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) recommended this test to study health related physical fitness programme in youth[4]. Physical fitness is defined as ability to carry out daily tasks with vigour and alertness without undue fatigue with ample energy to enjoy leisure time pursuits, to meet unusual situations and unforeseen emergencies[5].

The key concept in testing physical fitness is that of a person's pulse rate and, in particular, how quickly this returns to normal after exercise. It is important that the pulse rate returns to normal after exercise, otherwise the heart is put under continuous stress.

The negative impact of obesity on physical fitness has been documented; however, this issue has not been explored in youth. The purpose of this study was to examine the relationship between body mass index (BMI) and physical fitness in adult population.

Material and Methods

This cross-sectional study was carried out on eighty students (37 males and 43 females) of chemistry department of Gujarat University, Ahmedabad, with age group 18-25 years. The study was conducted after taking permission from institutional ethical committee and authority of chemistry department of Gujarat University, Ahmedabad.

Inclusion criteria: Healthy subjects, who volunteered to participate in the study, were included.

Exclusion criteria: Subjects with medical and surgical conditions such as diabetics, hypertension and other cardiac, renal, respiratory disease and chronic disease were excluded from the study.

1. Physical Anthropometry:

Physical measurements (i.e. height, weight and body mass index) of participants were recorded.

Weight: The weight was measured in kilogram in the upright position without shoes using a weighing machine having precision of 0.5 kg. Checks on the scale were made routinely before recording the weight of each participant.

Height: The height was measured by making the person to stand upright, barefoot on the ground with heels, buttocks and shoulders touching the wall and feet close together to the nearest 0.1 cm. The height was measured using a steel measuring tape graduated in centimetre (0-500).

Body Mass Index (BMI): Body mass index (BMI) was calculated by Quetelet Index, which is a statistical measure of the weight of a person scaled according to height. It was developed in 1832 by the Belgian polymath Adolphe Quetelet[6].

Body Mass Index (BMI) was calculated based on the formula-

BMI = Weight in kg/Height in mt^2

The subjects were divided into 4 groups based on BMI:

Group I : BMI < 18.5,

Group II : BMI ≥18.5 to < 25

Group III : BMI ≥ 25 to < 30

Group IV : BMI ≥ 30

2. Measuring physical fitness index (PFI):

Modified Harvard step test (HST): Harvard step test was first introduced by Brouha et al [7] in 1943 from Harvard fatigue laboratory in USA to select army personnel during World War II. The objective of Harvard step test is to measure physical fitness for muscular work and the ability to recover from work. HST has become well known to study cardio vascular fitness by American Alliance for health physical Education Recreation and Dance (AAHPRD) who recommended this test to study health related physical fitness programme in youth[4]. The step test is based upon the idea that a client with a higher level of cardiovascular fitness will have a lesser increase in heart rate, and that following the exercise, the heart rate will return to normal faster than a client who has much lower level of cardiovascular fitness. This is known as pulse recovery rate[8].

Physical fitness index (PFI): Physical fitness is assessed by cardiopulmonary efficiency test like Physical Fitness Index by using Modified Harvard Step Test (HST)[3].The Subject was advised to step up on the modified Harvard steps of 30 cms height once every two seconds (30 per minute) for 5 minutes, a total of 150 steps. Immediately after exercise participants sat quietly in a chair and the heart rate was measured for 30 seconds after exactly 1 minute and at the following time points: 1 to 1.5 minutes, 2 to 2.5 minutes and 3 to 3.5 minutes after the end of exercise. Physical fitness index was calculated by using the following equation:

$$\textbf{PFI} = \frac{\text{Duration of exercise (seconds)}}{\text{2 x sum of three recovery pulse rate For 30 seconds periods (1-1.5min, 2-2.5min, 3-3.5min)}} \times 100$$

The fitness of the subject will be graded on basis of score of PFI as,

<= 50: poor

51-60: average

61-70: good

71-80: very good

81-90: Excellent

>90 : Superb

Statistical analyses:

Standard descriptive statistics (percentages, means, and standard deviations) were computed to describe the sample. Chi square and T tests were performed to confirm statistical association among observed variables. Pearson Correlation (R) was used to test the hypothesis to determine the relation between physical fitness index and BMI. A p-value <0.05 was considered significant.

Result:

Table 1: Comparison of Anthropometric Parameters and physical fitness index between male and female

Variables	Mean ± SD		T Test	P value
	Male(37)	Female(43)		
Age (year)	20.92 ± 0.5	21.26 ± 1.26	1.5393	0.1278*
Height (m)	1.72 ± 6.47	1.57 ± 5.41	0.1129	0.9104*
Weight (Kg)	63.08 ± 12.73	48.93 ± 9.44	5.6949	< 0.0001***
BMI (Kg/ m^2)	21.3 ± 4.00	19.5 ± 3.82	2. 0561	0.0431**
Physical fitness index (PFI) (%)	73.96 ± 6.91	71.01 ± 6.09	2. 0298	0.0458**

*Not Significant, **Significant, ***Highly Significant

Table 2 : Represents the mean values of physical fitness index of the subjects according to PFI category

PFI category	PFI (%)				Total
	Male(37)		Female(43)		
	No.	%	No.	%	
<= 50: poor	0	0	0	0	0(0%)
51-60: average	2	2.50	2	2.50	4(5%)
61-70: good	9	11.25	15	18.75	24(30%)
71-80: very good	20	25.00	19	23.75	39(48.75%)
81-90: Excellent	6	7.50	7	8.75	13(16.25%)
>90 - Superb	0	0	0	0	0(0%)

Chi square= 1.159, df = 3, p value= 0.763

It was observed from table 1 that, physical parameters like, mean height, weight and BMI were higher among male than female. Physical fitness index was also better in male as compared to female participants. Difference of weight, BMI and PFI among male and female were statistically significant.

The physical fitness of 37 male and 43 female was evaluated using modified Harvard step method. Table 2 shows that 16.25% participants had excellent physical fitness. None of the participants had poor or superb fitness. Among male participants, distribution of average, good, very good and excellent physical fitness index was 2.5%, 11.25%, 25% and 7.5 % respectively. Among female participants, distribution of average, good, very good and excellent physical fitness index was 2.5%, 18.75%, 23.75% and 8.75% respectively. No significant difference was observed between male and female physical fitness.

Table 3 shows that, physical fitness of male was better than female. According to above results, as BMI increased, PFI decreased in both sex. This difference of PFI in overweight and obese participants was also statistically significant.

Table 3: Represents the mean values of physical fitness index of the subjects in male and female

BMI	PFI (%) (Mean ± SD)		T Test	Result
	Male(37)	Female(43)		
Group I : BMI < 18.5	75.95 ± 4.29	74.63 ± 5.96	1.1201	0.2661*
Group II : BMI ≥18.5 to < 25	74.89 ± 4.18	71.61 ± 6.88	2.5253	0.0136**
Group III : BMI ≥ 25	67.98 ± 8.40	64.11 ± 7.07	2.2377	0.0281**
Group IV : BMI ≥ 30	64.28 ± 1.60	61.96 ± 1.68	6.2950	< 0.0001***

*Not Significant, **Significant, ***extremely Significant

Table 4: Represents the mean values and SD of physical fitness index of the subjects in the various BMI groups and various BMI parameters along with correlation between BMI and Physical fitness index (PFI)

BMI	No.	Wt (kg)	Ht (m)	BMI (kg/m^2)	PFI	Pearson Correlation (R) Test	P Value
Overall	80	55.48 ± 3.10	1.64 ± 9.46	20.48± 3.95	77.59 ± 6.72		
Group I (< 18.5)	26	44.81 ± 5.65	1.63 ± 8.59	16.67± 1.45	80.04 ± 5.45	-0.4265	0.00007985 (p <.0001) Extremely Significant
Group II (≥18.5 to <25)	39	54.62 ± 7.05	1.63 ± 9.64	20.44 ± 1.36	78.23 ± 5.85		
Group III (≥ 25)	13	74.77 ± 9.42	1.67 ±10.05	26.53 ± 1.13	72.21 ± 8.14		
Group IV (≥ 30)	2	85.5 ± 3.44	1.65 ± 16.67	31.39 ± 1.52	68.12 ± 1.64		

Table 4 represents the mean values of physical fitness index of the subjects in the various BMI groups, confirmed a decrease in the mean values of physical fitness index as the BMI of the subjects increases and shows negative correlations in the physical fitness index with BMI. The Pearson Correlation (R) was used to test the hypothesis to determine the relation between PFI and BMI. This negative correlation of the physical fitness index with BMI in all groups was extremely significant (p <.0001).

Figure 1: Represents correlation between the mean values of BMI and physical fitness index (PFI)

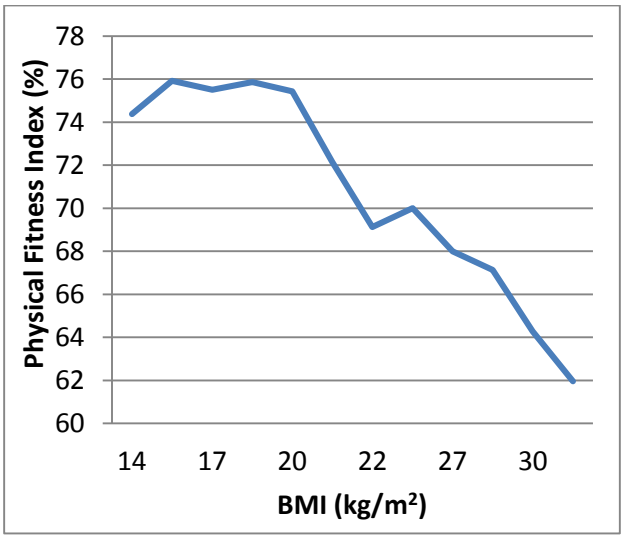

Figure 1 also shows negative correlations in the physical fitness index with BMI. The mean values of physical fitness index decreased as the BMI of the subjects increased.

Discussion:

Physical fitness is an important health marker in the youth; therefore there is the need of meaningful and accurate physical fitness assessment in young people. Before the industrial revolution, fitness was the capacity to carry out the day's activities without undue fatigue. However with automation and changes in lifestyles physical fitness is now considered a measure of the body's ability to function efficiently and effectively in work and leisure activities, to be healthy, to resist hypokinetic diseases, and to meet emergency situations. Importance of physical fitness has been mentioned in the history of mankind including Vedas. Yet, physiology of exercise is a recent advancement and is an open field for research [9].

The present study evaluated the physical fitness in adult population of Ahmedabad using modified Harvard step test method. Eighty participants with a mean age of 21.10 years and mean BMI of 20.48 Kg/m^2 were evaluated for physical fitness in this study by using Modified Harvard Step Test. Ganeriwal et al [10] performed the HST on the 51 Indian adults with age group of 17-25 years using stepping height of 18 inches. Banerajee PK and Chatterjee S [11] also studied the effectiveness of the Harvard step test in assessing the physical fitness in 54 Indian adolescent boys.

The present study showed that males are having better physical fitness as compared to their female counterpart. The gender difference in physical fitness observed in the present study is because of the tendency for female to be less physically active than male. In fact, girls are not keeping up with the

boys when comparing their participation rates in physical activity and sport. Girls may shy away from organized sport activities. Rao et al [12] also had done study on 240 university students in which he found that physical activity was more among boys (62%) as compared to girls (38%). Lack of time and laziness or lack of motivation was also reported by over 50% of the students to be the most important hindering factors for practice of regular physical activity, which may be cause for lower physical fitness in girls.

In this study, majority of subjects had normal BMI. Average BMI of male was little higher than the average BMI of females. This study also showed that the physical fitness index of the subjects differed significantly from one another in the various BMI categories, with the subjects of normal BMI possessing a higher fitness than the overweight or obese subjects. It was found from present study that BMI was inversely proportional to physical fitness index (figure 1). Fitness capacity therefore decreased progressively as the BMI increased. This view is supported by the finding of Sameer Srivastava et al [13] who conducted a study on 18-25 years college students and concluded that Fitness capacity decreased progressively as the BMI increased. Present study also agrees with the study done by Anabel et al [14] which showed that the overweight and obese individuals exhibit lower levels of physical fitness.

These results correlate with other studies that researched the same variables [15, 16, 17]. The overweight and obesity are associated with lowered muscle strength [17, 18]. Leila Jaafari et al [19] had done study of anthropometric measures focusing on health indices and physical fitness and concluded that there was a negative significant between most of health-related anthropometric measures and physical fitness factors which is also consistent with our finding.

Future research needs to examine methods for increasing physical fitness levels among this population group and identify cut-points related to health outcomes for all fitness components. There is a need to encourage physical activity in adults and also to emphasize the importance of inculcating physical activity in their lifestyle.

Conclusion:

From the present study, it is concluded that physical fitness is negatively affected to a great degree in Young adults who are overweight and obese. Although the negative health effects of poor health-related physical fitness are not necessarily present at this age as a sickness or a disease, it is apparent that obesity is the precursor of various chronic diseases, which includes hypertension, type II diabetes mellitus, coronary heart disease and hyperlipidaemia. Statistics worldwide also indicate that the obesity rates seen among these young adult will most probably not improve in the future. The information obtained from this study can therefore be used in the compilation of health related fitness programmes and awareness of use of yoga and physical training. The study, however, had a shortcoming that must be taken into account when interpreting the results. The subject size was relatively small, which made generalization of the results difficult.

References:

1. Shah C ; Diwan J ; Rao P ; Bhabhor M; Gokhle P ; Mehta H : Assesment obesity in school children, Calicat medical journal 2008: 6(3): e2.
2. Aboderin I, Kalache A, Ben-Shlomo Y, Lynch JW, Yajnik CS, Kuh D, Yach D. Life course perspectives on coronary heart disease, stroke and diabetes; the evidence and implications for policy and research. Geneva, 2002.
3. Sunil KR, Das. Determination of physical fitness index (PFI) with modified Harvard Step Test (HST) in young men and women. Ind J Physiol & Allied Sci 1993; 47(2):73-76
4. Safrit MJ. Introduction to measurement in physical education and exercise science. Times Mirror Ed. Mosby College Publishing; 1986: 250.
5. Clarke HH. Basic understanding of physical fitness. Physical fitness Research Digest series 1971; 1:2
6. Eknoyan G, Adolphe Quetelet (1796–1874)—the average man and indices of obesity. Oxford Journals, Nephrology Dialysis Transplantation , 2007; 23(1): 47-51
7. Brouha, Lucien. The Step Test: A Simple Method for Measuring Physical Fitness for Muscular Work in Young Men, Res.Quart. 1943; 14: 31-36.

8. Srivastava S, Dhar U, Malhotra V. Correlation between physical fitness and body mass index. IJCRR. 2013; 5(23): 44-48.
9. Wuest DA, Bucher CA. Historical foundations of physical education and sport. 13th Ed. Boston, Mass: WCB/McGraw Hill; 1999:146–193
10. Ganeriwal SK, Sen SC, Khandare SS. Test of physical fitness (Harvard step test) in indian female. Indian J Med Res 1968; 56:845-849
11. Chatterjee S, Banerajee PK. Harvard step test as a measure of physical fitness in adolescent boys. Indian J Med Res 1983;79:413-7
12. Rao. Physical activity among medical students practice, International Journal of Preventive Medicine, 2012; 3(5): 365-369,
13. Sameer Srivastava. Correlation between physical fitness and body mass index, Int J Cur Res Rev,2013; 05 (23) : 44-48
14. Anabel NR, Anselmo JP, Luciana C, Nazare SB. The association between cardio-respiratory fitness and cardiovascular risk in adolescent. J Paediatria (Rioj) 2007; 83(5):1-12
15. Graf C, Koch B, Kretshmann-Kandel E, et al. Correlation between BMI, leisure habits and motor abilities in childhood (CHILT-Project). Int J Obesity 2004; 28: 22–6.
16. Chen LJ, Fox KR, Haase A, Wang JM. Obesity, fitness and health in Taiwanese children and adolescents. Eur J Clin Nutr 2006; 60: 1367-1375.
17. Tokmakidis SP, Kasambalis A, Christodoulos AD. Fitness levels of Greek primary schoolchildren in relationship to overweight and obesity. Eur J Pediatr 2006; 165: 867–874.
18. Wearing SC, Hennig EM, Byrne NM, Steele JR, Hills AP. The impact ofchildhood obesity on musculoskeletal form. Obes Rev 2006;7:209-218
19. Leila Jaafari. Health-related anthropometric measures in connection with physical fitness factors; IPEDR vol.31 (2012)

Source Of Financial Support	Nil
Conflict Of Interest	None