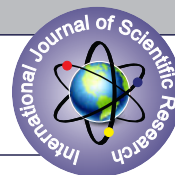


EVALUATION OF FITNESS INDEX SCORE BY HARVARD STEP TEST IN YOUNG MEDICAL COLLEGE CRICKETERS & CONTROL GROUP AT RAJASTHAN



Physiology

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ABSTRACT

Objective - To evaluate aerobic fitness by Harvard Step Test Fitness Index Score in age & gender matched cricketers group & sedentary lifestyle group
Methods - Research was conducted at Dr. S.N. Medical College Jodhpur. Approved by Institutional Ethical Committee. Study design was Observational Analytic Comparative Cross Sectional Study. Written informed consent was taken from 40 Human male subjects out of which 20 Cricketers & 20 Sedentary Life stylers between 20-24 years of age were included out of randomly recruited subjects; those have answered NO to Physical Activity Readiness Questionnaires. Intervention was of Cricket sport of 20-20 overs version of 3 hours duration in afternoon session with frequency 3-5 days of week ; acclimatized for one year. Harvard Step test ; Requires : Step up on to a standard gym bench (45 cm high) once every 2 seconds for 5 minutes (150 steps) with the help of downloaded Metronome. Using the three recovery radial pulse rate; 1 minute after, 2 minutes after, 3 minutes after finishing the test ; level of fitness can be known by applying formula & categorization was done as given in Brian Mackenzie's; Performance Evaluation Test. Fitness Index Score = $30000 / (\text{pulse1} + \text{pulse2} + \text{pulse3})$. Normative data for the Harvard step test following category are available for Evaluation in males = Excellent >90, Above Average 80-90, Average 65-79, Below Average 55-64, Poor <55 For statistical analyses micro-soft office, excel sheet, graph pad software, numbers and percentages, mean and standard deviations chi square test, unpaired t test. Pearson's correlation coefficient, p value < 0.05 was considered as statistically significant were used.

Result - In our study in male subjects of Cricketers group (n=20); age in years was (Mean±SD 22.25±1.33), while in that of sedentary group (n=20) age was (Mean±SD 22.3±0.80 (p=0.886) Resting Heart Rate in Cricketer's group (Mean±SD 73.05±4.14) was less (P=0.086) than in Sedentary group (Mean±SD 76.15±6.7). Fitness Index score by harvard step test in cricketer's group (Mean±SD 83.31±5.79) was significantly more (P<0.0001***) than in sedentary group (Mean±SD 71.84±2.73) Cricketers group fitness index score mean category was in Above Average range while that of sedentary group was in Average range category. A negative correlation was observed between Resting HR & Fitness Index Score in Cricketers group (r = -0.3.99, p=0.081)

Conclusion - In cricketer's group of medical students, aerobic capacity in form of fitness Index score was in above average category & significantly more & associated with decrease in heart rate in comparison with sedentary life-style group of medical college students. Hence intervention of healthy lifestyle in form of cricket sport improves aerobic fitness.

KEYWORDS

Cricket Harvard Step Test Aerobic Fitness Index Score

INTRODUCTION -

Physical fitness is used in the context of two meanings: General fitness (a state of health and well-being) and specific fitness (the ability to perform specific sports or occupational skills). Fitness can be further subdivided into five categories: Cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition. The criteria for physical fitness has also expanded to include the capacity to meet physical demands in an emergency situation. Physical fitness is the capacity of the heart, blood vessels, lungs and muscles to function at optimum efficiency. In previous years, fitness was defined as the capacity to carry out the day's activities without undue fatigue. However, with increased leisure time, and changes in lifestyles wrought by the industrial revolution which took a large proportion of the population away from farm life and into more urban areas, this definition is no longer considered comprehensive enough. The definition for physical fitness is now defined as the body's ability to function efficiently and effectively in work and leisure activities, not only at a set point in time, but at various ages and stages within a person's life cycle. The key is in finding optimum health within the limits of one's lifestyle in order to be able to resist hypokinetic diseases. (Those conditions that occur as a result of a sedentary lifestyle. Examples would include obesity and complications arising from obesity, such as diabetes.) Many health professionals today, including doctors, nurses, occupational therapists, and physical therapists, agree that the ideal approach is a holistic approach—one that provides many options and allows a person to make decisions and be proactive in regards to their own personal health. (1) Cricket is a popular game played between two teams, generally of 11 members each. In essence,

it is single combat, in which an individual batsman does battle against an individual bowler, who has helpers known as fielders. It is wildly popular in India, England, and Australia etc. (2) Evaluation tests can be broken down into two main types: Maximal tests, where the athlete works at maximum effort or tested to exhaustion, and Sub- Maximal tests, where the athlete works below maximum effort and extrapolation is used to estimate maximum capacity. The results from an evaluation test can be used to: predict future performance, indicate weaknesses, measure improvement, enable the coach to assess the success of the training program, place the athlete in appropriate training group, motivate the athlete (3) Physical condition called fitness means fitness for work, fitness for play, fitness for anything a man may be called upon to do. The Harvard Fatigue Laboratory was a focal point in the development of exercise physiology in the United States. Dr. D. B. Dill directed the laboratory from its opening in 1927 until its closing in 1947. The body of research in exercise and environmental physiology produced by that laboratory forms the basis of much of what we know today. By the early to mid 1980s, it had become clear that physical inactivity was a major public health concern. In 1992, the American Heart Association made physical inactivity a major risk factor for cardiovascular diseases, just like smoking, high blood pressure, and high serum cholesterol. In 1995, the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine published a public health physical activity recommendation that "Every U.S. adult should accumulate 30 minutes or more of moderate intensity physical activity on most, preferably all, days of the week". (4) Step up fitness tests have been developed to measure aerobic fitness using a simple test requiring

minimal equipment and space. These tests vary in the step heights, stepping frequency, physiological measures and results calculations, and as such vary in their suitability for specific populations. The equipment required will vary on the test being conducted. The step or platform needs to be of solid construction, and will vary in height between 15-50 cm or 6-20 inches. Other requirement includes a stopwatch, and you may need a metronome or pre-recorded cadence tape depending on which procedure you are using. pre-test: Explanation of the test procedures to the subject is given, screening of health risks is done and informed consent is obtained. In procedure: steps up and down on the platform at a given rate for a certain time or until exhaustion. Heart rate is recorded during the test and/or for some period afterwards as per specific step test A score can be calculated, which is then compared to normative values to determine a fitness rating. **The Harvard Step test** is a test of aerobic fitness, developed by Brouha et al. (1943) in the Harvard Fatigue Laboratories during WWII. The features of this test is that it is simple to conduct and requires minimal equipment. There are many other variations of step tests too. **equipment required:** step or platform 20 inches / 50.8 cm high, stopwatch, metronome or cadence tape. **validity:** correlation to VO_{2max} has been reported as between 0.6 to 0.8 in numerous studies. **advantages:** This test requires minimal equipment and costs, and can be self-administered. Disadvantages are that Biomechanical characteristics vary between individuals. For example, considering that the step height is standard, taller people are at an advantage as it will take less energy to step up onto the step. Body weight has also been shown to be a factor. Testing large groups with this test will be time consuming. (5)(6) The Harvard step test is a simple test of physical fitness for strenuous muscular exercise. It requires no special skill on the part of the subject and it may be applied, with appropriate modifications, to healthy children, adolescents, or adults of either sex. The "fitness index" calculated from this test is useful in the allocation of individuals to duties within their physical capacity and in the assessment of response to physical training. The fitness index is not related to height, weight, length of leg, or width of pelvis but subjects with a slow resting pulse tend to have a high fitness index. During the Second World War the Harvard step test was used in the selection of combat officers. Since the war the original test or some modification of it has been applied to athletes, lumbermen, soldiers, aviation cadets, students, boys and girls. Result revealed significantly higher fitness indices for students who were track athletes, boxers, or weight lifters than for other students; there was significantly higher fitness indices for students of physical education than medical students. Testing military recruits, found that individuals having certain above body weight had a lower fitness index. Research showed rapid improvement in a group of soldiers when the step test was repeated three times a week. (7) In a study in 1st Year Medical Students, the mean Harvard index or PFI score was found to be 82.0101 in males. (8) The study in Physiotherapy students reflected that females are having excellent physical fitness when compared to their male counterparts. 45% of female subjects had excellent physical fitness whereas only 12% of males studied had excellent physical fitness. 33% percent of the males had poor physical fitness whereas only 16% of females had poor physical fitness. This study has clearly established that physical activity is an important determinant and predictor of physical fitness. (9) In a research at Rajeev Gandhi University of Health Sciences Karnataka; PFI score in physical education students was 96.6 ± 9.0 significantly more (<0.001) than medical education students 74.7 ± 13.4 (10). In our study the research question was to evaluate, How much Aerobic Fitness (Fitness Index Score) status are in College level Cricketers group & Sedentary control group?

MATERIAL & METHODS-

Our research was conducted at Dr. S.N. Medical College Jodhpur; after approval of plan by Institutional Ethical Committee in year 2021. Study Design was Observational Analytic Comparative Cross Sectional Study. Cricketers subjects (Cricket is a bat ball game between two team of eleven players on field includes batting, bowling & fielding. (11) & Sedentary Life-style subjects (Limited physical activity or no regular physical activity outside work) (12) Inclusion criteria- At least 40 Human male subjects out of which 20 Cricketers & 20 Sedentary Life style follower between 20-24 years of age were included randomly; those have answered NO to Physical Activity Readiness Questionnaires. Exclusion Criteria - Human subjects will be excluded those have answered YES to one or more questions of Physical Activity Readiness Questionnaires (13) or those having general indication for stopping the exercise test (during exercise) in low risk adults Onset of angina or angina-like

symptoms, Shortness of breath, wheezing, leg cramps, or claudication, Signs of poor perfusion: light-headedness, confusion, ataxia, pallor, cyanosis, nausea, or cold and clammy skin, Failure of heart rate to increase with increased exercise intensity, Noticeable change in heart rhythm, Subject requests to stop, Physical or verbal manifestations of severe fatigue, Failure of the testing equipment. (14). Evaluation between Sedentary lifestyle related Medical College Students Group & Physically active Cricketers Group in Dr. S. N. Medical College Students Group having intervention of Cricket as Sport 20-20 overs of 3 hours time in afternoon session with frequency 3-5 days of week; acclimatized for one year, were done by knowing Fitness Index Score by Harvard Step test; reflects aerobic fitness development of the athlete's cardiovascular system. Required resources To undertake this test requires: Gym bench (45cm high) Stop watch Assistant. The Harvard step test is conducted as follows: Step up on to a standard gym bench once every 2 seconds for 5 minutes (150 steps) with the help of downloaded Metronome. Using the three recovery pulse rate; 1 minute after, 2 minutes after, 3 minutes after finishing the test; level of fitness can be determined as follows: Result = $30000 / (\text{pulse1} + \text{pulse2} + \text{pulse3})$. Normative data for the Harvard step test following category are available for Evaluation in males Excellent >90 , Above Average 80-90, Average 65-79, Below Average 55-64, Poor <55 (15) To know recovery heart rate; Radial Pulse was recorded in sitting position as given in Hutchison's Clinical Methods (16) In statistical analysis the data was collected in Microsoft office excel sheet. All statistical analyses were performed using Graph Pad software. The qualitative data were expressed in numbers and percentages for categorical variables and the quantitative data were expressed as mean and standard deviations for continuous variables. The difference in proportion was analysed by using chi square and Fisher exact test. The difference in mean among the groups was analysed using Unpaired t Test. Pearson's correlation coefficient between quantitative variables. A p value <0.05 was considered as statistically significant.

OBSERVATION & RESULT

Table 1: Comparison Of Fitness Index Score By Harvard Step Test between Cricketers Group (n=20) & Sedentary Group (n=20)

Harvard step test	Cricketers Group (Mean±SD)	Sedentary Group (Mean±SD)	t value	p value
Age (yrs)	22.25±1.33	22.3±0.80	0.143	0.886
Resting HR (bpm)	73.05±4.14	76.15±6.7	1.761	0.086
Recovery Pulse after 1 min (bpm)	133.75±8.96	156.8±6.89	9.121	<0.0001***
Recovery Pulse after 2 min (bpm)	121.75±8.23	138.5±8.11	6.483	<0.0001***
Recovery Pulse after 3 min (bpm)	106.3±10.48	122.85±4.18	6.557	<0.0001***
Fitness Index Score = $30000 / (\text{Pulse 1} \pm \text{Pulse 2} \pm \text{Pulse 3})$	83.31±5.79	71.84±2.73	8.023	<0.0001*** Highly Significant

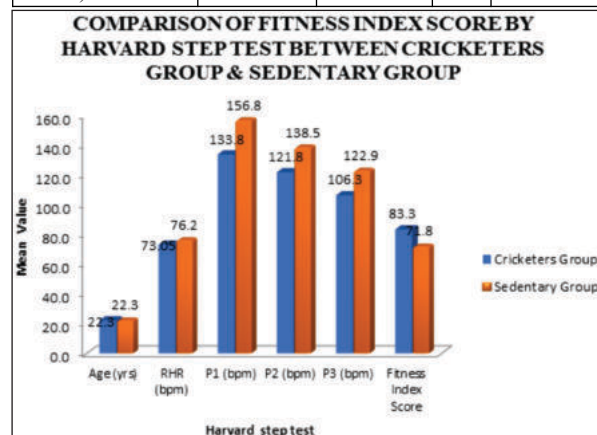


Table 2: Evaluation Of Pfi Category By Harvard Step Test Of Cricketers Group (n=20) And Sedentary Group (n=20)

Score	Cricketers Group N (%)	Sedentary Group N (%)	Chi square value	p value	Remark

Excellent >90	0 (0%)	0 (0%)	24.00	< 0.0001	Highly significant
Good (80-90)	15 (75%)	0 (0%)			
Average (65-79)	5 (25%)	20 (100%)			
Below average (55-64)	0 (0%)	0 (0%)			
Poor <55	0 (0%)	0 (0%)			

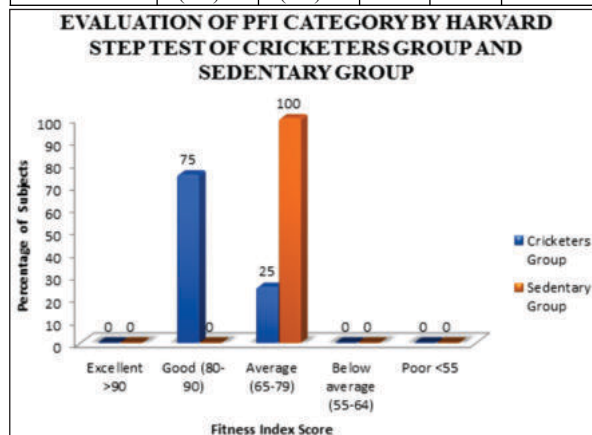
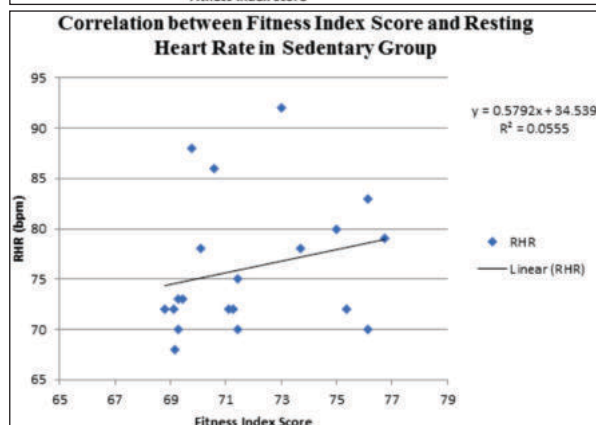
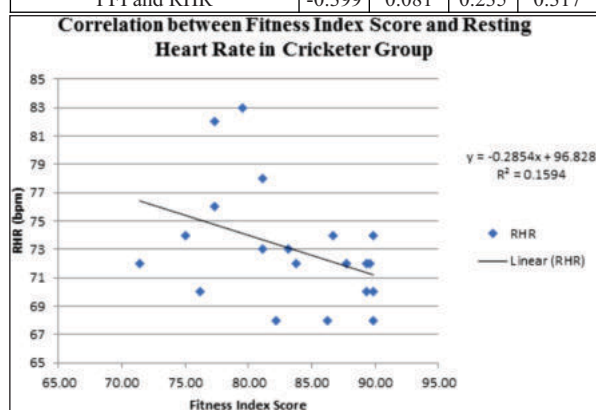


Table - 3: Pearson's-correlation coefficient between

	Cricketer Group		Sedentary Group	
	r value	p value	r value	p value
PFI and RHR	-0.399	0.081	0.235	0.317



DISCUSSION -

Health Benefits of playing Cricket includes Increased Stamina and Endurance: the constant running across the field helps to increase stamina. Balance: balance is also something one can improve through this sport because of the utmost concentration required while playing cricket. Flexibility: learning to move freely is something that comes with practice in cricket, thus improving on flexibility of an individual. Coordination: when catching or throwing the ball, a cricket player improves his hand eye coordination Cardio: Cricket includes a lot of throwing and sprinting across the field, which is a great cardiovascular activity. Improved Motor Skills: Bowling, batting and catching the ball require gross motor skills. These are such activities that make the large

body muscles to work. Social Skills: it's a great way to interact with people and it's also a great way to learn to cope with winning or losing. Cricket matches can last several hours, and within that time one must work with the team in a cooperative manner to develop and initiate game strategies and win the match. Muscle Toning: like any other sport, cricket also helps with gaining and toning your muscles. Physical Fitness: all the sprinting and bowling requires you to be constantly up and running, which increases your physical activity level. Team Building: it is a team sport. Eleven players must work together for several hours on the field, utilizing strategies to defeat the other team. Children playing cricket learn cooperation and other social skills, while building a sense of pride and accomplishment when their team wins. Even adults can enjoy the opportunity to foster friendships outside of the office. Victory is all the sweeter when shared. (2) In our study age of 20 male subjects of Cricketers group in ($n = 20$) in years was ($\text{Mean} \pm \text{SD } 22.25 \pm 1.33$), while age that of sedentary group ($n = 20$) age was ($\text{Mean} \pm \text{SD } 22.3 \pm 0.80$). In comparison there was no significance difference between age of these two groups was found ($p = 0.886$) means further comparison in following variables were done between age matched groups. In our study Resting Heart Rate in Cricketer's group ($\text{Mean} \pm \text{SD } 73.05 \pm 4.14$) was less ($P = 0.086$) than in Sedentary group ($\text{Mean} \pm \text{SD } 76.15 \pm 6.7$). Resting heart rate decreases after endurance training: Wilmore et al found small but significant decreases in resting heart rate (2.7 to 4.6 beats.min⁻¹ at 72 hours post training) after a 20 week endurance training programme. (17) Smith et al investigated the mechanism behind bradycardia. They suggested that the decrease in resting heart rate after training was due to changes in the intrinsic rhythmicity of the heart and an increase in the predominance of parasympathetic control. The sympathetic contribution to heart rate decreases slightly (18) In our study fitness Index score by harvard step test based on recovery heart rate that reflects aerobic capacity in cricketer's group ($\text{Mean} \pm \text{SD } 83.31 \pm 5.79$) was significantly more ($P < 0.0001^{***}$) than in sedentary group ($\text{Mean} \pm \text{SD } 71.84 \pm 2.73$) & in evaluation as per Brian Mackenzie's Book Harvard Step Test Endurance table (15); Cricketers group fitness index score mean category was in Above Average range while that of sedentary group was in Average range. In our study Non significant negative correlation was observed between Resting HR & Fitness Index Score in Cricketers group ($r = -0.399, p = 0.081$) while in sedentary group Nonsignificant positive correlation. ($r = 0.235, p = 0.317$) was observed. In another research Physical fitness was assessed in two groups of young college students, sedentary ($n = 188$) and physically active ($n = 164$), by a modified Harvard step test suitable for Indian subjects. Mean PFI score was found to be significantly higher ($p < 0.001$) in the physically active group of students. It was found that PFI scores of more than 65% of the total of 352 students fell in the 'average' category. PFI was found to have significant negative correlation ($p < 0.001$) with resting heart rate in sitting as well as standing postures. The results obtained in the present investigation once again revealed the much poorer physical fitness level of Indians by comparison with westerners. (19) Research showed The mean PFI score of the precollegiate subjects were found to be 103.25 ± 16.83 & category wise distribution of the subjects as per PFI scores by pie chart; fall in the following categories: Excellent = 24%, good = 22%, fair = 26%, and poor 28% as per PFI Scores. The PFI correlated with VO₂ max ($r = 0.238, P < 0.02$). Aerobic capacity correlated with BSA and did not correlate with BF% and BMI. (20) The Harvard step test (HST) assesses the physical fitness of individuals. Results showed Score of PFI Mean & SD was 59.54 ± 20.99 further height of subjects positively and significantly correlated to the fitness score and also to the duration of exercise. The mean fitness scores of subjects with height ≥ 1.66 m were significantly higher than mean scores of subjects with height < 1.66 m. Means The shorter duration of effort and the lower score in short subjects may be due to muscle fatigue rather than cardio-respiratory impairment. (21) There is strong scientific evidence on the benefits of physical activity for health. International and national recommendations are available on physical activity counselling for primary health care providers. Exercise in medicine in Russia is in the process of development. The further implementation of the physical activity recommendations depends on the one hand on their inclusion in the curricula of medical universities and on the other hand on the creation of ways for involving and motivating primary health care providers to counsel patients in this area. (22) Increased Physical Activity is advocated in NPCDS National Programme for prevention and control of Cancer, Diabetes, Cardiovascular disease and Stroke (23) Fit India Movement is a nation-wide movement in India to encourage people to remain healthy and fit by including physical activities and sports in their daily lives. Fit India Movement was launched by Prime Minister of India Narendra Modi at Indira Gandhi

Stadium in New Delhi on 29 August 2019 (National Sports Day). The campaign has a "Fitness Pledge" that reads, I promise to myself that I will devote time for physical activity and sports every day and I will encourage my family members and neighbours to be physically fit and make India a fit nation (24) The Board of Control for Cricket in India (BCCI) is the autonomous governing body for cricket in India and is under the jurisdiction of ,Ministry of Youth Affairs & Sports Government of India.(25)

CONCLUSION -

In cricketer's group of medical students , aerobic capacity in form of fitness Index score was in above average category & significantly more & associated with decrease in heart rate in comparison with sedentary life-style group of medical college students. So intervention of healthy lifestyle in form of cricket sport improves fitness standard of individual & public as various physical fitness related programmes are launched in country India.

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