Evaluating Cardiovascular and Muscular Endurance in Students of Sports Sciences and Physical Education (SS&PE): A Comprehensive Fitness Analysis

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Abstract

This experimental study investigates cardiovascular and muscular endurance among students pursuing a Bachelor of Science (BS) degree in the Department of Sports Sciences and Physical Education (DSS&PE) Mohi-ud-Din Islamic University (MIU) Nerian Sharif, Azad Kashmir. The research, conducted during the initial semester of 2023, faced challenges in assessing upper body muscular endurance, abdominal muscular endurance, and cardiovascular fitness for a total population of 44 students. Adopting L. R. Gay's guidance, a 20% sample (10 students) was selected using a simple random sampling technique to ensure representativeness. Three separate tests, namely the Harvard step test for cardiovascular fitness and push-ups and curl-ups from the standardized FITNESGRAM test for upper body and abdominal muscular endurance, respectively, were employed. The tests were standardized with established parameters. Focusing on health-related components from a total of 11 physical fitness elements, the study revealed poor cardiovascular fitness among students, warranting special

attention, equipment, and training methods. Upper body endurance, assessed through push-ups, indicated a poor fitness zone, while abdominal muscular endurance was found to be average. Recommendations include increased attention to relevant equipment for enhancing muscular endurance and positive changes in practical classes within the SS&PE department. Additionally, students may improve their muscular endurance through overworking and overloading, fostering stronger muscles and increased endurance.

In conclusion, students within the SS&PE domain demonstrated poor cardiovascular and upper body muscular endurance, with average abdominal muscular endurance. These findings underscore the importance of targeted interventions and fitness programs to enhance specific areas of physical fitness among the students.

INTRODUCTION

This is probably the most popular and frequently used term in physical education and to develop physical fitness is the most important objective of physical educators. Physical fitness is a multidimensional state of being. It is the body's ability to function efficiently and effectively and a state of being that consists of at least five health-related and six skill-related physical fitness components, each of which contributes to total quality of life (Bedaso & Mekonnen, 2023). Although it is generally agreed that physical fitness is an important part of the normal growth and development of a child, a generic definition regarding the precise nature of physical fitness has not been universally accepted. Through research and scholarly inquiry, it is clear that the multi-dimensional characteristics of physical fitness can be divided into two areas: health related physical fitness and skill related fitness (Cattuzzo et al., 2016). The health-related components of physical fitness are categorized as cardiorespiratory endurance, muscular endurance, muscular strength, body composition, and flexibility. Just as the sum of physical activity ranges from low to high, so does the level of physical fitness. Furthermore, the levels of the five health-related components usually differ in performance, for example, a person may be flexible but not strong. The five health-related modules of physical fitness are essential to community health than are the components related to athletic/students' ability. The skill-related components of physical fitness are

categorized as agility, balance, coordination, speed, and reaction time. These entire skill-related have always been used by previous researchers in their study.

Physical fitness is not a static factor and it varies from individual to individual and in the same person from time to time depending on factors. Physical fitness is probably the most popular and frequently used term in Physical Education. The most important objective of physical educators is to develop physical fitness. Fitness is the ability to live a full and balanced life. The totally fit person has a healthy and happy outlook on life. Fitness is the young man's absolute necessity. It breeds self- reliance and keeps man mentally alert. Physical fitness is essential for human beings to adjust well with his environment as his mind and body are in complete harmony (Deng, A., & Chen, 2022).

Six tests from Fitness-gram battery were used. Both girls and boys with obesity performed a significantly reduced number of tests in healthy fitness zone suggesting a decrease of performances in strength and cardiovascular fitness, from normal weight status to overweight and from overweight to obesity. Boys and girls with obesity are likely to be Under Healthy Fitness Zone [HFZ] than normal weight. The results suggest that obese and overweight children have low PF level compared to normal weight peers. A large number of children with normal weight were identified as well as unfit. These data also showed that a low BMI level would significantly improve some PF component. This departure from the traditional notion of fitness has resulted in a clear differentiation between physical fitness related primarily to athletic ability. This type of fitness has enormous benefit to our life style as it allows us to be active throughout day (Wright & Irwin, 2018). For example working to the shops climbing stairs or running to catch a bus it also allows us to get involved in sports and pursuits if we have good cardiovascular fitness then our health is also good

Co-curriculum for university students is a major component, and it is mostly attached to the graduation requirements enshrined in students' rules and regulations guidebook. From the co curriculum activity, students are giving a chance to integrate well with different racial backgrounds (Abdullah et al., 2018)). Rahman (2022) noted that researchers had found a positive association between the co-curricular activities and the academic performance of the students. The co-curriculum activities make

the students tough enough for the future time and develop a sense of competitive spirit, leadership, cooperation, diligence as well as serve as the backdrop for the development of their creative talents (Yirgalem, 2018).

Physical fitness is a cornerstone in the domain of Sports Sciences and Physical Education (SS&PE), and understanding the specific dimensions of cardiovascular and muscular endurance among students is paramount. Despite the acknowledged importance of these fitness components, there exists a gap in knowledge regarding the current status of cardiovascular and muscular endurance among BS 1st semester students enrolled in SS&PE programs at Mohi-ud-Din Islamic University in the year of 2023. This research seeks to address this gap by conducting a comprehensive fitness analysis, aiming to identify the levels of cardiovascular and muscular endurance in the student population. By pinpointing potential areas of improvement or excellence, the study aims to contribute valuable insights that can inform targeted interventions and curriculum enhancements within the university setting, ultimately optimizing the physical well-being and performance of SS&PE students.

METHODS AND MATERIAL

Research Method

The data collection for this study employed a quantitative approach, and the study's nature was experimental in design.

Population

This study centered on students enrolled in the Department of Sports Sciences and Physical Education (SS&PE) during their initial semester pursuing a Bachelor of Science (BS) degree at Mohi-ud-Din Islamic University, admitted in the year 2023. The particular class under investigation encompassed a total of 44 students.

Sample and Selection of the Sample

With a total population of 44 individuals, the experimental nature of the study posed challenges for the researcher in assessing all students' upper body muscular endurance, abdominal muscular endurance, and cardiovascular fitness. To address this practical hurdle, the researcher adopted the guidance of L. R. Gay (1987) and selected a 20% sample from the entire population. Consequently, the study's sample size comprised 10 students (20% of 44), chosen through a simple random sampling technique. This

strategic approach aimed to navigate the complexities of the study while ensuring a representative subset for analysis.

Tool for Data Collection

The researcher used three different tests for three research questions. The first test was Harvard step test to evaluate the cardiovascular fitness of the subjects, the second and third test was adopted from the standardized FITNESGRAM test. The push-ups test was used to evaluate the upper body muscular endurance of the subjects and third test curl-ups was used to test the abdominal muscular endurance of the subjects. All the above mentioned tests were standardized and established with their own parameters.

Procedure

For the Harvard step test administration the subject who was taking the test after the warm up steps up and down on a platform in a cycle of two seconds. The platform was at a height of about 50 cm or 20 inches. The rate of 30 steps per minute sustained for five minutes or until exhaustion. To ensure the right speed, a metronome was used. Exhaustion is the point at which the subject cannot maintain the stepping rate for 15 seconds. The subject immediately sits down on completion of the test, and the heartbeats are counted for 1 to 1.5.

The push-up to an elbow angle of 90 degrees is the recommended test for upper body endurance. The PACER (Progressive Aerobic Cardiovascular Endurance Run) test CD contains a recorded cadence of 20 push-ups per minute (1 push-up every 3 seconds). The tests ends if a student: 1- stops to rest; 2-does not achieve a 90 degree angle with elbows on each rep; 3-does not maintain correct body position; 4-does not extend arms fully (FITNESSGRAM, 1999)

For the curl-up test, the students complete as many curl-ups as they can at a specified pace (maximum 75). The curl-up has been selected because it does not involve the assistance of the hip flexor muscles and minimizes compression in the spine, when compared to a full sit-up with the feet held. Endurance of the abdominals are important in promoting good posture and correct pelvic alignment. (FITNESSGRAM, 1999).

Data Analysis

Mean and Standard Deviation was computed. Comparison was made on the basis of activity i.e. Mohi-ud-Din Islamic University 1st

year male sport science physical education students in the year of 2023. For this purpose 'T' test was applied. All analyses were performed using the IBM SPSS Statistics (v. 21) and data are shown as mean ± SD. An alpha value of $p < 0.05$ was set as the criterion level of significance.

RESULTS AND DISCUSSION

This particular portion deals with the presentation, interpretation, analysis and discussion of the data. The two main health related physical fitness variables were measured and evaluated in this chapter the first was cardiovascular fitness of the BS level students of sports sciences and physical education and second variable was muscular endurance. The researcher uses FITNESSGRAM variable Push-up (upper body Muscular endurance) and Curl-ups for abdominal muscular endurance. The data were summarized in the tables and result of the study presented as below.

Table 1: Showing the Parameter for Cardiovascular fitness administered through Harvard step test

The outcome of the equation is rated as follows

Rating	Fitness index
Excellent	> 97
Good	83 – 96
Average	68 – 82
Low average	54 – 67
Poor	< 54

The table 1 shows that after the applying specific equation suggested by Harvard step test if the test results comes 97 or above than the 97 then the respondent has excellent cardiovascular fitness. In case of 83 to 96 results the person has good cardiovascular fitness, in case of 68 to 82 the respondent has average cardiovascular fitness. The score "between" 54 to 67 shows the low average cardiovascular fitness zone of the person and in last 54 and below than 54 score shows the person in poor cardiovascular fitness condition.

Table 2: Showing the respondents information and detail of the test

Subjects	Height (Feet)	Weight (Kg)	Test Timing (Mint)	Pulse rate (Second)
Subject 1	5.5	62	1.16	112
Subject 2	5.6	55	1.16	127
Subject 3	5.6	61	1.13	109
Subject 4	5.9	60	1.17	117
Subject 5	5.7	62	1.16	90
Subject 6	5.11	75	1.16	109
Subject 7	5.7	76	1.16	113
Subject 8	5.6	50	1.16	87
Subject 9	5.6	80	1.16	113
Subject 10	5.5	55	1.16	110

Table 2 shows that the student at serial number one has 5 feet and 5 inches height, 62 kilogram weight. The student performed his activity in 1 minute and 16 seconds and pulse rate immediate after activity during 75 seconds was 112. The student at serial number two has 5 feet and 6 inches height, 55 kilogram weight. The student performed his activity in 1 minute and 16 seconds and pulse rate immediate after activity during 75 seconds was 127. The student at serial number three has 5 feet and 6 inches height, 61 kilogram weight. The student performed his activity in 1 minute and 13 seconds and pulse rate immediate after activity during 75 seconds was 109. The student at serial number four has 5 feet and 9 inches height, 60 kilogram weight. The student performed his activity in 1 minute and 17 seconds and pulse rate immediate after activity during 75 seconds was 117. The student at serial number five has 5 feet and 7 inches height, 62 kilogram weight. The student performed his activity in 1 minute and 16 seconds and pulse rate immediate after activity during 75 seconds was 90. The student at serial number six has 5 feet and 11 inches height, 75 kilogram weight. The student performed his activity in 1 minute and 16 seconds and pulse rate immediate after activity during 75 seconds was 109. The student at serial number seven has 5 feet and 7 inches height, 76 kilogram weight. The student performed his activity in 1 minute and 16 seconds and pulse rate immediate after activity during 75 seconds was 113. The student at serial number eight has 5 feet and 6 inches height, 50 kilogram weight. The student performed his activity in 1 minute and 16 seconds and pulse rate immediate after activity during 75 seconds was 87. The student at serial number nine has 5 feet and 6 inches height, 80

kilogram weight. The student performed his activity in 1 minute and 16 seconds and pulse rate immediate after activity during 75 seconds was 113. The student at serial number ten has 5 feet and 5 inches height, 55 kilogram weight. The student performed his activity in 1 minute and 16 seconds and pulse rate immediate after activity during 75 seconds was 110.

Table 3: Cardiovascular fitness test results of the respondents

Subjects	Height (ft)	Weight (Kg)	Test Timing	Pulse rate	Test time * 100	Pulse rate * 2	Score
Subject 1	5.5	62	76	112	7600	224	33.93
Subject 2	5.6	55	76	127	7600	254	29.92
Subject 3	5.6	61	73	109	7300	218	33.49
Subject 4	5.9	60	77	117	7700	234	32.91
Subject 5	5.7	62	76	90	7600	180	42.22
Subject 6	5.11	75	76	109	7600	218	34.86
Subject 7	5.7	76	76	113	7600	226	33.63
Subject 8	5.6	50	76	87	7600	174	43.68
Subject 9	5.6	80	76	113	7600	226	33.63
Subject 10	5.5	55	76	110	7600	220	34.55
Mean Cardiovascular fitness score = 35.28							

Table 3 showing the cardiovascular fitness of students after formulation. The test timing in seconds multiplied with hundreds of each subject and pulse rate of each subject was multiplied with 2. The result of test time multiplied by 2 divided by pulse rate multiplied by 2 and score of subject in serial number one is 33.93 which was less than 54 (33.93 < 54) which indicates that the subject has poor cardiovascular fitness. Similarly, the subject in serial number two has scored 29.92 which is less than 54 (29.92 < 54) which indicates that the subject has poor cardiovascular fitness. In the same way, the subject in serial number three scored 33.49 which is also less than 54 (33.49 < 54) which indicates that the cardiovascular fitness of subject is poor. Likewise, the subject on serial number four scored 32.91 which is less than 54 (32.91 < 54) which indicates that the cardiovascular fitness of the subject is poor. Similarly, the subject at serial number five scored 42.22 which is less than 54 (42.22 < 54) which indicates that the subject has poor cardiovascular fitness. In the same way the subject at

serial number six has scored 34.86 which is less than 54 (34.86 < 54) which indicates that the subject has poor cardiovascular fitness. Consequently, the subject at serial number seven scored in cardiovascular fitness test 33.63 which is less than 54 (33.63 < 54) which indicates that the cardiovascular fitness of the subject is poor. In the same way, the subject at serial number eight scored 43.68 which is also less than 54 (43.68 < 54) which indicates that the cardiovascular fitness of the subject is poor. Similarly, the subject at serial number nine scored 33.63 which is less than 54 (33.63 < 54) which indicates that the cardiovascular fitness of the subject is poor. The subject at serial number ten scored 34.55 which is less than 54 (34.55 < 54) which indicates that the last subject has poor cardiovascular fitness. Cumulatively, the results shows that the students of BS 1st semester has poor cardiovascular fitness and even only one student has not scored in low average zone because the mean score was 35.28 which is less than the 54 (35.28 < 54).

Table 4: Upper body muscular endurance results of the subjects
The Description of fitness zone of Push-Ups of BS 1st Semester
The FITNESGRAM Standards for healthy fitness Zones for boys (17+ = > 35)

Subjects	Height (ft)	Weight (Kg)	Push-Up # completed	Fitness zone
Subject 1	5.5	62	18	Poor
Subject 2	5.6	55	25	Poor
Subject 3	5.6	61	16	Poor
Subject 4	5.9	60	15	Poor
Subject 5	5.7	62	15	Poor
Subject 6	5.11	75	17	Poor
Subject 7	5.7	76	16	Poor
Subject 8	5.6	50	18	Poor
Subject 9	5.6	80	22	Poor
Subject 10	5.5	55	19	Poor
Mean of all subjects in Push-Ups			**17.72**	**Poor**

Table 4 showing that the FITNESGRAM standards for healthy fitness zones for boy having age 17 and above was less than 35 pushups considered in poor upper body muscular endurance. The results shows that, the subject at serial number one scored 18 pushups which was less than 35 (18 < 35) which indicates that the upper body muscular endurance of the subject is poor. In the same way the subject at serial number two scored 25 pushups which was less than 35 (25 < 35) which indicates that the upper body muscular

endurance of the subject is poor. Similarly, the subject at serial number three scored 16 pushups which was less than 35 (16 < 35) which indicates that the upper body muscular endurance of the subject is poor. Subject at 4 number scored 15 pushups which is less than 35 (15 < 35) which indicates that the subject has poor upper body muscular endurance. The subject at serial number five scored 15 pushups which is less than 35 (15 < 35) which shows that the upper body muscular endurance of the subject is poor. The subject at serial number six has scored 17 pushups which was less than 35 (17 < 35) which indicates that the upper body muscular endurance of the subject is poor. The subject at serial number seven scored 16 pushups which was less than 35 (16 < 35) which indicates that the upper body muscular endurance of the subject was poor. The subject at serial number eight scored 18 which was less than 35 (18 < 35) which indicates that the subject has poor upper body muscular endurance. The subject at serial number nine scored 22 which was less than 35 (22 < 35) which indicates that the subject has poor upper body muscular endurance. The last subject at serial number ten scored 19 pushups which was less than 35 (19 < 35) which indicates that the upper body muscular endurance of the subject was poor. Cumulatively, the mean of all subjects in pushups was 17.72 which was less than 35 (17.72 < 35) which indicates that the upper body muscular endurance of the BS 1st Semester students was poor.

Table 5: Abdominal muscular endurance results of the subjects
The Description of fitness zone of Curl-Ups of BS 1st Semester
The FITNESGRAM Standard for healthy fitness zones boys (17+ = > 47)

Subject	Height (ft)	Weight (Kg)	Curl-Ups # completed	Fitness zone
Subject 1	5.5	62	30	Average
Subject 2	5.6	55	20	Below Average
Subject 3	5.6	61	28	Below Average
Subject 4	5.9	60	22	Below Average
Subject 5	5.7	62	30	Average
Subject 6	5.11	75	35	Average
Subject 7	5.7	76	35	Average
Subject 8	5.6	50	35	Average
Subject 9	5.6	80	37	Average
Subject 10	5.5	55	36	Average
Mean of Curl-Ups			**33.17**	**Average**

Table 5 showing the results of the subjects of abdominal muscular endurance tested through cur-ups test. The results shows that the subject 1st performed 30 curl-Ups, 2nd performed 20, third performed 28, 4th performed 22, 5th performed 30, 6th performed 35, 7th performed 35, 8th performed 35, 9th performed 37 and last subjects at serial number ten performed 36 curl-ups. The subjects at serial number 2, 3 and 4 were in below average fitness zone on the other hand the subjects at serial number 1, 5, 6, 7, 8, 9 and 10 were in average fitness zone the mean of the subjects were 33.17 which is above than 17 and less than 47 which indicates that the abdominal muscular endurance of the subjects was in average zone.

DISCUSSION

The main focus of the researcher on evaluating cardiovascular and muscular endurance in students of sports sciences and physical education (SS&PE): a comprehensive fitness analysis. The researcher applied Harvard step test to evaluate the cardiovascular fitness of the respondents and the researcher found that the cardiovascular endurance of the students of sports sciences and physical education was in poor zone because not only one students cross the lowest level of parameter and all students score poor zone score as mentioned in data analysis. Tomes et al (2017) a comparatively several numbers of studies have measured physical fitness in students and athletes background, and as a result, variety field-based fitness test batteries have been developed to evaluate fitness in this population. The pre and post fitness scores were compared to general fitness norms by using several parameters which are a muscular strength, and cardiovascular fitness. The test used to evaluate their physical fitness parameter is grip strength, abdominal strength and back strength for muscular strength. For body composition, they take the recruits body weight and percentage of body fat. For cardiovascular fitness, the diastolic and systolic blood pressure with resting and recovery heart take was recorded. The reading of right and left hamstring was recorded for flexibility measurement. The results show that compared to the general population, the athlete as well students were found to be normally above the average fitness level. Their finding has further highlighted the need for any uniform the students' package units to stay fit throughout their careers (Abdullah et al., 2017).

The researcher applied pushups test for upper body muscular endurance adopted from well-established FITNESGRAM test. The researcher found that the upper body muscular endurance of the students of sports sciences and physical education was in poor zone. Amongst the four measures of musculoskeletal fitness (i.e., muscle strength, endurance, and flexibility), only the 90^{o} push-up and back saver sit-and-reach tests were associated with two other musculoskeletal measures. Specifically, 90^{o} push-up was positively associated with curl-up and sit-and-reach, but not trunk lift scores; sit-and-reach was positively associated with trunk lift and 90^{o} push-up scores, but not curl-up. As previously articulated, Fitness Gram® testing results are often not sent home to parents, and there are years when some schools do not perform these tests at all. The resulting lack of awareness on the part of parents regarding their students' fitness and indirect implications for potential risk of adverse health outcomes may partly underlie parents' poor recognition of high inactivity levels among youth (Ajisafe, 2019). The researcher administered curl ups test to evaluate the abdominal muscular endurance the test was adopted from FITNESGRAM test. The researcher found that the abdominal muscular endurance of the students of sports sciences and physical education was in average zone. The results of Bebcakova, (2015) point to minor differences in the level of abdominal strength and endurance between urban and rural students and students living in a flat or a house. Urban students performed better than those living in a rural area (1.5 %) as well as students living in a flat than students living in a house (2.5 %). Statistical analysis showed that there is no relationship between the distribution of HFZ standards and residence area or housing type in both males and females. Minor differences in results are contrary to the results reported by Minatto et al (2012) who found that adolescents from rural areas presented at almost 10 times higher chance of inadequate muscle strength/endurance than those from urban areas. Also, a study by Andrade et al (2014) and Chillón et al (2011) showed that with respect to residential location, urban adolescents had significantly higher mean score curl-ups ($p < 0.01$) than rural ones. For upper body strength and endurance, urban students showed higher achievement rate percentage than rural students (3.1 % distinction). On the contrary, students living in a flat showed higher level upper body strength and endurance compared with students living in a flat (5.7 % distinction). Statistical analysis proved that the

distribution of HFZ (Healthy Fitness Zone) standards depends on type of housing only in females.

CONCLUSION AND RECOMMENDATIONS

The primary objective of this study centered on conducting a comprehensive fitness analysis, specifically focusing on cardiovascular and muscular endurance among students pursuing sports sciences and physical education (SS&PE). While there were a total of 11 physical fitness components, the researcher deliberately selected health-related components, narrowing the focus to cardiovascular fitness and muscular endurance. The established parameters for cardiovascular fitness categorized scores into Excellent (>97), Good (83–96), Average (68–82), Low average (54–67), and Poor (<54). The study revealed that students exhibited poor cardiovascular fitness, with none greater the threshold score of 54 the lowest in the established parameters, however the concerned authorities and personnel may pay special attention on the cardiovascular fitness of the students, special equipment and training method may be adopted for this particular purpose. Additionally, the assessment of upper body endurance through push-ups indicated a poor fitness zone among the students. On a more positive note, the research found that abdominal muscular endurance was, on average, across all respects. However the researcher recommended that the concerned authority (DSS&PE) should give more attention to the relevant equipment for enhancing muscular endurance and also take some positive steps to systematic change in practical classes in DSS&PE. Furthermore, the students may increase their muscular endurance through overworking and overloading. Overworking makes muscles stronger and gives more endurance to students. In conclusion, the researcher inferred that students within the SS&PE domain demonstrated poor cardiovascular and upper body muscular endurance, while their abdominal muscular endurance fell within the average range.

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