

ORIGINAL ARTICLE

Evaluation of cardiorespiratory fitness among undergraduates of Rehman Medical Institute: a cross-sectional study

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ABSTRACT

Background: Cardiorespiratory fitness is the capability of the circulatory and respiratory system to supply oxygen to the body. It is the interplay between the cardiac and pulmonary systems to ensure an effective supply of oxygen to the body. In the young generation, cardiorespiratory fitness predicts several health conditions, such as cardiometabolic health and mental health. This study was designed to determine the cardiorespiratory fitness among the undergraduate students of Rehman Medical Institute.

Methods: This research study was cross-sectional in which 322 students were recruited from five colleges of Rehman Medical Institute (RMC, RCRS, RCD, RCN, RCAHS), and systematic sampling was used. Data was gathered using a self-administered questionnaire and a 3-minute step test. The analysis was done using SPSS version 22.

Results: Out of a total population of 322, the maximum number of participants, 41.6% (n=134), were in excellent fitness levels, and the least number of participants were in the poor fitness category with a percentage of 1.9% (n=6). Among the five colleges of RMI, Rehman College of Allied Health Sciences (RCAHS) ranked first with the highest excellent fitness score of 38.8%, while Rehman College of Rehabilitation Sciences (RCRS) ranked last with an excellent fitness score of 9.7%.

Conclusion: This thorough study brought us a set of knowledge regarding the cardiorespiratory fitness of students. From the present study, it is concluded that the majority of undergraduate students had excellent fitness scores, with a percentage of 41.6% and Rehman College of Allied Health Sciences had the highest excellent fitness score, which is 38.8%.

Key Words: Cardiorespiratory fitness, Undergraduate, VO₂ max.

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INTRODUCTION

Cardiorespiratory fitness is the capability of the circulatory and respiratory system to supply oxygen to the body(1). It is the interplay between the cardiac and pulmonary systems to ensure an effective supply of oxygen to the body(2). In the young generation, cardiorespiratory fitness predicts several health conditions, such as cardiometabolic health and mental health(3). Research conducted in Pakistan shows that there is a possible effect of body mass index on cardiorespiratory fitness (the normal range is 18.5 to 24.9)(4). A study conducted in 2016 states that decreased cardiorespiratory fitness in young adults with increased body fat could be contributing to cardiac problems in middle age(4). Maximal oxygen consumption (VO₂ Max) is the gold standard for measuring cardiorespiratory fitness. The highest amount of oxygen that a person can use when exercising is known as their VO₂ max(4). Over the past six decades, cardiorespiratory fitness has decreased worldwide. The reasons are an increase in obesity, an increase in sedentary lifestyles, and social and

economic changes. A recent statement of the American Heart Association (AHA) declares that cardiorespiratory fitness should be considered an essential vital sign, as it is a powerful mortality predictor in adults(3). Cardiorespiratory fitness is one of the essential variables that should be assessed in health screening(5). Improvements in cardiorespiratory fitness led to adaptations in the body that led to better oxygen supply. Increased blood volume enhanced ventricular compliance, greater cardiac contractility, and angiogenesis are the changes that result in improved cardiac output. Cardiovascular disease is one of the leading causes of death worldwide. One of the key elements in lowering cardiovascular events globally is increasing cardiorespiratory fitness(3). Low cardiorespiratory fitness is responsible for several diseases, such as coronary artery disease, hypertension, type II diabetes, obesity, cancer, high cholesterol, decreased lung compliance, and chronic obstructive pulmonary disease. These non-communicable diseases caused by low cardiorespiratory fitness are the leading cause of

death worldwide, accounting for 71% of all deaths globally, of which 77% of deaths are in middle and low-income countries(6). Strong evidence exists that shows the benefits of physical activity and cardiorespiratory fitness on cardiovascular disease risk reduction through modifying risk factors such as body fatness, blood pressure, blood lipids, and insulin resistance(7). Cardiorespiratory fitness has been shown to enhance mental health. It has been shown that an increase in academic achievement is associated with the advantages of cardiorespiratory fitness for cognition, brain plasticity, anatomy, and function. A study conducted in 2023 indicates that physically active students have better coordination, cardiorespiratory fitness, and academic achievement than those students who are physically inactive(8).

Depression is one of the serious disabilities that is affecting many students. Improvement in cardiorespiratory fitness is also related to improvement in mental health, and this plan should be implemented in mental health clinics(9). A study conducted in 2017 states that the cardiorespiratory fitness of their students was low(10). According to research conducted in 2024, third and final-year students did not exceed the recommended cardiorespiratory thresholds set by the World Health Organization (WHO)(11). Research conducted on cardiorespiratory fitness of medical students in 2023 found that students have very poor fitness levels 43.6%, poor fitness levels 29.3%, below average fitness level 9.8%, average fitness levels 6.5%, above average fitness level 5.4%, and good fitness level 5.4%(2). According to a study conducted on medical students in 2022, the VO₂ max of males and females was 46.79 and 36.15, respectively(6). A study conducted in 2018 states that enhancement in cardiorespiratory fitness was associated with a 16.1% reduction in cardiovascular disease mortality and a 14.0 percent reduction in cancer mortality(12). A study conducted in 2022 states that for every 1 metabolic equivalent increase in cardiorespiratory fitness, the risk factors are reduced by 0.89%(13). Another study conducted in 2020 shows that students with compromised

cardiorespiratory fitness are at risk of cardiometabolic disease(14). According to a 2023 study, 14% of obese children have low cardiorespiratory fitness.(15).

Another study conducted in 2021 states that a 3-minute step test is an effective assessment method for cardiorespiratory fitness(16). A study conducted in 2018 discovered that greater body mass index (BMI), waist circumference (WC), obesity, and metabolic syndrome in later life were linked to worse cardiorespiratory fitness in childhood and adolescence (17). Another study conducted in 2019 states that the step test was recorded to have an adequate correlation with directly measured VO₂ max in fit children aged 7–10 years(18). A study conducted in 2022 found that 20 minutes of everyday vigorous physical activity was best for maximizing cardiorespiratory fitness(19). A study conducted in 2020 states that high-intensity interval training greatly improves cardiorespiratory fitness(20). Another study conducted in 2021 found an inverse association between physical activity and sleep quality(21). Another study conducted in 2016 found that volleyball players had significantly higher VO₂ max (39.07±11.4ml/kg/min) than basketball players (25.46± 15.7ml/kg/min)(22). A study conducted in 2018 states that higher cardiorespiratory fitness is associated with increased survival and decreased incidence of cardiovascular diseases(23). Students need to measure their cardiorespiratory fitness for their benefit, and it will improve their productivity. The more productive students the better they will perform in their academic years. A competent practitioner needs to be mentally and physically strong because today's students will be tomorrow's practitioners. As cardiorespiratory fitness is not evaluated in students of Rehman Medical Institute (RMI) this study focuses on researching undergraduate students to assess their cardiorespiratory fitness. Objectives of the study were to determine the cardiorespiratory fitness among undergraduate students of Rehman Medical Institute (RMI) and to compare cardiorespiratory fitness among different colleges of Rehman Medical Institute (RMI).

Table 1: Standard Fitness Scores

Fitness Score	Age 18-25 Male Female	Age 18-25 Male	Age 18-25 Female Age 26- 35 Male	Age 26-35 male	Age 26-35 Female
Excellent	<82	<88	<83	<91	
Above Average	83-94	89-103	84-94	92-106	
Average	95-104	104-116	95-106	107-118	
Below Average	105-118	117-128	107-119	119-129	

Poor	>119	>129	>120	>130
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MATERIAL AND METHODS

The research study was a cross-sectional study and comprised Rehman Medical College (RMC), Rehman Colleges of Dentistry (RCD), Rehman College of Rehabilitation Sciences (RCRS), Rehman College of Allied Health Sciences (RCAHS), and Rehman College of Nursing (RCN). The sampling technique was a probability sampling technique (systematic random sampling). The required sample size was 322, using an online sample size calculator, OpenEpi. The data tool that was used for the data collection was a self-administered questionnaire and a 3-minute step test. The purpose of a three-minute step test is to measure an individual's level of aerobic fitness. To increase heart rate and determine the heart rate of recovery in the 60 sec that follow the three-minute step test activity, participants step up and down, on and off, during the step test. The data were gathered following the RCRS graduate studies committee's approval of the proposal. The goal of the study was presented to each college principal in order to obtain their approval. Students who fit the inclusion requirements were recruited for the studies, and students were assured of the confidentiality of their data. The data was analyzed using SPSS version 22. The results from different RMI colleges were compared using a chi-square test. The standard fitness scores are mentioned in Table 1.

RESULTS:

Data was collected and analyzed from a total of 322 students. Out of 322 participants, 51.9% (n=167) were male, while 48.1% (n=155) were female, with a mean age of $2.63 \pm .855$ S.D. The demographic information is presented in Table 2.

Fitness level of participants:

Out of a total population of 322, the maximum

number of participants, 41.6% (n=134), were at an excellent fitness level; the rest of the data is given in the table below. Out of five colleges of Rehman Medical Institute (RMI), the excellent fitness score from Rehman Medical College (RMC) was 33.33% (n=28), Rehman College of Dentistry (RCD) was 42.2% (n=14), Rehman College of Rehabilitation Sciences was 36.11% (n=13), Rehman College of Allied Health Sciences (RCAHS) was 43.3% (n=52) and Rehman College of Nursing (RCN) was 55.1% (n=27). The fitness categories are given in Table 3.

Gender and BMI-wise distribution of fitness level

A total of 322 participants were included in the study, out of which 167 male participants had an excellent fitness score of 42.5% (n=71), and 155 female participants were included in the study, out of which 40.6% (n=63) participants were in the excellent fitness category. According to BMI, excellent fitness score in underweight individuals was 43.75% (n=14), normal BMI individuals was 43.75% (n=84), overweight was 37.03% (n=30), obese class I was 30.76% (n=4), obese class II was 66.66% (n=2), and obese class III was 100% (n=1). The rest of the data is given in Table 4.

Top fitness score among colleges:

Among five undergraduate colleges of Rehman Medical Institute (RMI), out of which Rehman College of Allied Health Sciences (RCAHS) had highest excellent fitness score (38.8%), followed by Rehman Medical College (RMC) with an excellent fitness score of (20.89%), followed by Rehman College of Nursing (RCN) with an excellent fitness score of (20.14%), Rehman College of dentistry (RCD) with an excellent fitness score of (10.4%) and lastly Rehman College of Rehabilitation Sciences (RCRS) with an excellent fitness score of (9.7%).

Table 2: Demographic Information

Variables	Categories	Frequency	Percentages
Gender	Male	167	51.90%
	Female	155	48.10%
Residence	Day-scholar	192	59.60%
	Hostelite	130	40.40%

Table 3: Fitness Levels of Students at RMI

Fitness Level of Participants	RMC	RCD	RCRS	RCAHS	RCN	Total
Excellent	28	14	13	52	27	134
Above Average	26	12	9	34	12	93
Average	19	4	11	21	5	60

Below Average	9	3	2	11	4	29
Poor	2	0	1	2	1	6
Total	84	33	36	120	49	322

Table 4: Gender and BMI-Wise Distribution of Fitness Levels.

Fitness Scores		Excellent	Above Average	Average	Below Average	Poor	Total
Gender	Male	71	46	30	18	2	167
	Female	63	47	30	11	4	155
BMI	<18.5 underweight	14	7	8	3	0	32
	18.5–24.9 Normal	84	56	32	17	3	192
	25.0–29.9 overweight	30	27	17	4	3	81
	30.0–34.9 obese class I	4	2	3	4	0	13
	35.0–39.9 obese class II	2	0	0	1	0	3
	>40 obese class III	0	1	0	0	0	1
Total		134	93	60	29	6	322

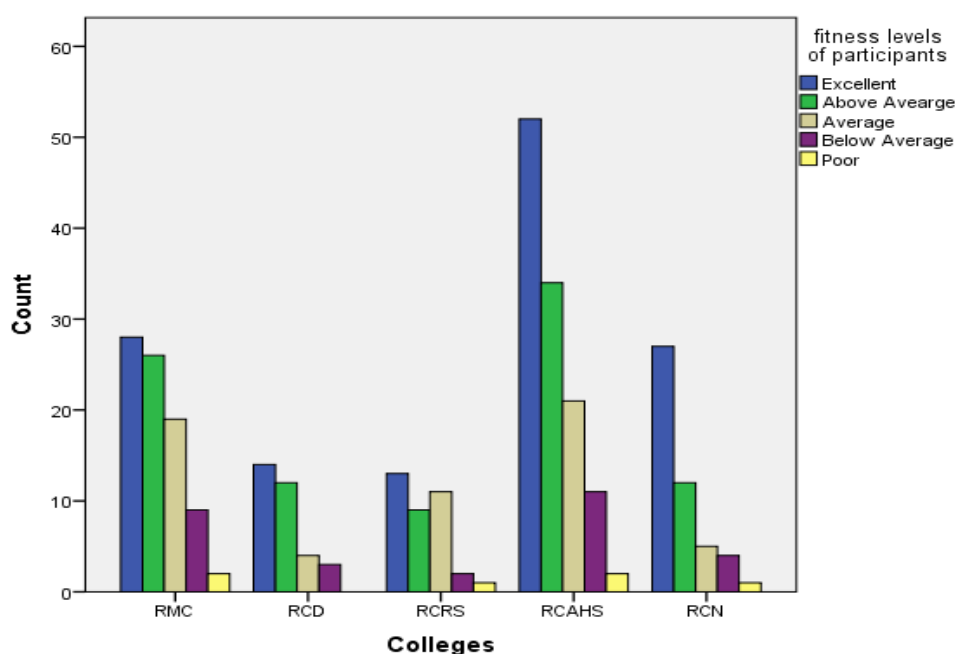


Figure 1: Top Fitness Scores Among Colleges

DISCUSSION

The purpose of the research study was to determine cardiorespiratory fitness on the basis of one-minute post-test heart rate recovery after a three min step test. The research study was conducted on healthy medical students of all five colleges of Rehman Medical Institute (RMI). A study conducted in 2023 states that 5.4% students had good cardiorespiratory fitness, 5.4% students were above average, 6.5% students were average, 9.8% students were below average, 29.3% students had poor cardiorespiratory fitness, and 43.6% students were in the very poor category(2). Whereas in our study, 41.6% students were in the excellent fitness range, 28.9% students were above average, 18.6% students were average, 9% students were below average, and 1.9% students

were in the poor cardiorespiratory fitness category. The main reason that most of the students at RMI have excellent fitness levels is their involvement in different sports activities, participating in sports week, using stairs to take classes, and the incorporation of co-curricular activities with medical education.

A study conducted in 2024 found that third and final year medical students had low cardiorespiratory fitness levels and did not meet the WHO-recommended levels. This study is in agreement with our study, in which third and final year students also had low fitness levels(11).

The reason behind this is that third year students had just been introduced to a new clinical environment, and the decline in fitness of final year is increased work and psychological burden.

Research conducted in 2020 suggested that cardiorespiratory fitness of male participants was greater than female participants, 28.7% male students were having excellent fitness level and 8.3% female students were having excellent fitness level. In our study 42.5% male students were in having excellent fitness level and 40.6% females students were in excellent fitness category(24). Our study is in agreement with the above stated statement. A 2022 cross sectional study states that cardiorespiratory fitness of medical students is inversely related to Body Mass Index (BMI)(25). A study in 2017 shows strong negative correlation between cardiorespiratory fitness and BMI. One of the study conducted in 2017 found that increase in BMI effects the physical fitness of an individual and reduces the VO₂ Max of the body of an individual(26). Another study conducted in 2022 states that the relationship between BMI and physical fitness was non-linear; their students came in underweight, overweight, and obese categories of BMI had the poorest results and physical fitness index than the normal weight category of BMI(25). The above statements are in agreement with our study results. The reason for negative correlation is that with increased BMI the individual becomes more sedentary, and the efficiency of systems decreases, resulting in cardiorespiratory fitness declines. A study conducted in 2024 showed that males had higher maximal oxygen consumption max than females(27). A systematic review conducted in 2019 found that Cardiorespiratory fitness is lower among women than among men. And it is in agreement with our result, the reason is that women have a different genetic makeup and physical strength than men(28).

CONCLUSION

From the present study, it is concluded that the majority of undergraduate students had excellent fitness scores. This thorough study brought a set of knowledge regarding the cardiorespiratory fitness of students. Considerable mass of participants came in excellent fitness category and among five undergraduate colleges of Rehman Medical Institute (RMI), Rehman College of Allied Health Sciences (RCAHS) had highest excellent fitness score, followed by Rehman Medical College (RMC), Rehman College of Nursing (RCN), Rehman College of dentistry (RCD), and lastly Rehman college of rehabilitation sciences (RCRS).

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