

CARDIORESPIRATORY HEALTH AND PHYSICAL FITNESS ASSESSMENT AMONG UNDERGRADUATE HEALTHCARE PROFESSIONALS: A CROSS-SECTIONAL COMPARITIVE EVALUATION

Dr. Ramsha Uzair^{*1}, Dr. Ifra Maryam², Humayun Imran Azeemi³,
Dr. Muhammad Salah Khan⁴, Kainat Ghulam Muhammad⁵, Dr. Muhammad Usman⁶

^{*1}Lecturer Department of Physical Therapy, Jinnah University for Women

²Lecturer University of Modern Sciences, TMK

³Assistant Professor Department of Health, Physical Education & Sports Sciences, University of Karachi

⁴Physical Therapist the Care Medical Center, Karachi

⁵Co Operative Lecturer Department of Physical Therapy, Jinnah University for Women

⁶Senior Assistant Professor Bahria University Health Sciences Campus, Karachi

^{*1}drramshauzair@gmail.com

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Corresponding Author: *

Dr. Ramsha Uzair

Abstract

Background: Cardiorespiratory fitness constitutes a fundamental indicator of overall physical health and metabolic function. Healthcare education professionals require substantial cardiovascular reserves to manage demanding clinical rotations and sustain extended work schedules. Limited data examine fitness profiles within allied health student cohorts. *Objective:* This investigation assessed cardiorespiratory fitness parameters among undergraduate healthcare professionals to establish baseline fitness profiles and identify risk factors for compromised cardiovascular function. *Methods:* A cross-sectional observational study enrolled 145 undergraduate students (age 18–26 years) from physical therapy (65.5%) and medical (34.5%) programs at a tertiary educational institution. Cardiorespiratory capacity was quantified using the Modified Harvard Step Test, with Physical Fitness Index calculations derived from exercise duration and heart rate recovery measurements. Body composition assessment utilized standardized anthropometric techniques. *Results:* Overall sample demonstrated mean Physical Fitness Index of 62.87 ± 15.33 , with 37.9% achieving excellent fitness ratings and 62.1% classified in satisfactory-to-suboptimal categories. Female students exhibited significantly lower fitness indices compared to males (mean: 58.4 ± 14.2 versus 68.1 ± 15.8 , $p < 0.05$). Year-three and fourth-year students demonstrated superior fitness compared to initial cohorts. *Conclusion:* Substantial proportion of allied healthcare students demonstrate suboptimal cardiorespiratory fitness despite pursuing professions demanding significant physical demands. Implementation of structured exercise programs integrated into professional curricula warrants consideration to enhance cardiovascular preparedness for clinical practice.

1. INTRODUCTION

Cardiorespiratory fitness is the ability of the lungs, heart, and muscles to work together. It is a measurable index of cardiovascular health, metabolic efficiency, and physiological resilience. Modern epidemiological data indicate robust links between reduced aerobic capacity and increased risk for cardiovascular disease, metabolic dysregulation, and early death across several demographic groups (1,2). Physical therapists, physicians and other healthcare professionals face occupational demands in clinical practice such as prolonged standing, frequent ambulation, sustained mental attention and occasional high intensity physical effort. Paradoxically, health care education programs often stress didactic knowledge acquisition with minimal incorporation of formal physical fitness curricula, creating a possible predisposition to cardiovascular deconditioning throughout long educational pursuits (3,4). Studies have shown that medical students often have less-than-optimal fitness levels, with sedentary studies, lack of leisure-time physical activity and academic schedules that limit opportunities for exercise being contributing factors (5,6). Limited empirical data exist characterizing cardiorespiratory fitness in allied health professional student populations, specifically about comparative fitness profiles across academic years and professional specialties. This study aimed to measure the aerobic capacity parameters of undergraduate students in healthcare-related fields and to assess the correlations between these parameters and demographic characteristics, body composition, and academic year. The study provided baseline data of fitness parameters and identified groups of students that require specific cardiovascular fitness training interventions.

2. Literature Review and Evidence Synthesis

Marques et al. (2016) studied the longitudinal relation between aerobic capacity as well as academic performance in student populations. The researchers found that, overall, higher cardiovascular fitness was linked with improved

measures of cognitive function and academic performance. The results indicated that increased cardiorespiratory capacity, which improves the transport of oxygen to the brain tissue, enhances cognitive function during challenging academic periods (7). Hasan et al. (2017) researched upon young adults and their cardiorespiratory fitness and adiposity. They found out that there is an inverse relationship between aerobic capacity and subcutaneous and visceral adiposity, which in turn supports the physiological link between cardiovascular fitness and metabolic health (8). Torres and colleagues (2022) found in their research the alarming rates of hypertension, dyslipidemia, and lower aerobic capacity in academic medical cohorts. Their study found that female medical students had more fitness-related risk factors as compared to males (9). Fan et al. (2020) studied the associations between lifestyle patterns and cardiovascular fitness parameters as well as heart rate recovery kinetics in young adult populations, the study concluded that lower fitness levels and slower heart rate recovery predicted future cardiovascular events and metabolic complications (10). Assessment Methodology. Kaminsky et al. (2013) performed a complete analysis of cardiorespiratory fitness assessment methods, comparing maximal exercise testing (ergotrometry) and submaximal step-test protocols, concluding that step-test procedures are reliable, practical, and cost-effective alternatives for population-level fitness screening in educational and occupational settings (11). Knappe et al. (2018) showed that decreased sedentary behavior patterns and increased moderate-to-vigorous physical activity engagement resulted in significant cardiorespiratory adaptations in 6-12 week intervention windows, suggesting that young adult populations respond favorably to structured exercise programming (12). Gender Differences in Fitness Hada Son et al (2013) compared the result of cardiorespiratory fitness test among Nepalese undergraduate students. They found significant gender differences in aerobic capacity, where females students had 15-20% lower fitness indices

compared to male students. This may be due to the combined effect of biological parameters and behavioral activity patterns (13). Pawaria et al., (2017) studied the fitness levels of physiotherapy students and found that 68% of the students enrolled in the program had poor baseline fitness, regardless of they were pursuing education in physical therapy, thus showing a paradoxically poor connection between the professional domain and personal health behaviors (14). Progression in Academic Year. Kumar et al. (2020) evaluated the cardiorespiratory fitness trajectories in medical students' cohorts during academic years. They found a gradual decline in fitness during the first to the third year, with minor recovery in the fourth-year students, possibly reflecting the effects of cumulative fatigue and subsequent modifications in the academic calendar (15). The findings have clinical and scientific implications for the measurement of cardiorespiratory fitness in healthcare student groups.

3. Methodology

3.1 Study Design and Setting.

This cross-sectional observational study recruited 145 undergraduate students from allied health programs in physical therapy (n = 95; 65.5%) and medicine (n = 50; 34.5%) from an academic institution with a diverse array of allied health science courses. Institutional Ethical Approval was acquired before subject enrollment. Convenient non-probability sampling was used, consisting of consecutive students meeting inclusion requirements during normal academic schedule.

3.2 Participant Characteristics. Inclusion criteria included undergraduate health professional student status, aging between 18–25 years, and absence of any cardiorespiratory contraindications. Exclusion criteria comprised recent upper respiratory infections or cough-related symptoms, current musculoskeletal injury or disability, psychological problems that would prevent exercise participation, recent surgical operations, and unwillingness to offer informed permission.

3.3 Fitness Assessment Protocol. Cardiorespiratory capacity was determined by the Modified Harvard Step Test, a recognized submaximal exercise regimen. Participants stepped repetitively on a conventional platform for 5 minutes at a rate of 30 steps per minute at a metronome rhythm. Heart rate measures were taken by pulse oximetry at one, three and five minute intervals of post exercise recovery. The Physical Fitness Index was calculated using a conventional formula: $PFI = [(exercise\ duration\ in\ seconds \times 100) / [2 \times \text{sum of three heart rate readings}]]$.

3.4 Body Composition Analysis. Anthropometric measures. Height and weight were measured using calibrated stadiometer and digital scale. Body mass index was determined using standard method (weight in kilos divided by height in meters squared). Additional body composition characteristics were obtained using bioelectrical impedance analysis.

3.5 Statistical Analysis. In order to better understand the demographic and fitness data, descriptive statistics like means, standard deviations, and frequency distributions were calculated. The Physical Fitness Index values were compared using independent samples t-tests, with the classifications of academic programs and gender. We used a one-way analysis of variance (ANOVA) to investigate the differences in level of fitness that existed between the different academic year groups. The Pearson correlation analysis was utilized in order to investigate the relationships that exist between the body mass index and the physical fitness index. data was analyzed using IBM SPSS Statistics version 23, statistical significance was defined as a p-value less than 0.05.

4. Results

4.1 Demographic Characteristics. The investigation enrolled 145 students with mean age 21.9 ± 1.7 years distributed across age categories: 18–20 years (20.7%, n=30), 21–23 years (62.1%, n=90), and 24–26 years (17.2%, n=25). Gender distribution demonstrated slight female predominance (55.2%, n=80) compared

to male participants (44.8%, n=65). Program enrollment included Doctor of Physical Therapy (65.5%, n=95) and Bachelor of Medicine (34.5%, n=50). Academic year distribution spanned first

year (33.8%), second year (12.4%), third year (5.5%), fourth year (17.9%), and integrated program participants (30.3%).

Table 1. Demographic Characteristics of Study Participants (n=145)

Demographic Variable	Number (n)	Percentage (%)	Mean±SD
Age (years)	145	100.0	21.9±1.7
18–20 years	30	20.7	—
21–23 years	90	62.1	—
24–26 years	25	17.2	—
Gender			
Male	65	44.8	—
Female	80	55.2	—
Program Enrollment			
Doctor of Physical Therapy	95	65.5	—
Bachelor of Medicine	50	34.5	—

4.2 Cardiorespiratory Fitness Assessment Results. Overall sample demonstrated mean Physical Fitness Index of 62.87 ± 15.33 (range: 37–89). Fitness rating distribution indicated 37.9% (n=55) achieving excellent fitness status (PFI>70), 21.4% (n=31) attaining very good ratings (PFI 60–70), 17.9% (n=26) achieving good ratings

(PFI 55–60), 13.8% (n=20) demonstrating high-average fitness (PFI 50–55), and 8.9% (n=13) showing below-average ratings (PFI<50). Mean heart rate recovery at one-minute post-exercise was 92.4 ± 11.2 beats per minute, improving to 84.3 ± 10.8 at three minutes and 76.1 ± 9.7 at five minutes.

Table 2. Physical Fitness Index Ratings and Distribution

Fitness Rating	PFI Range	Number (n)	Percentage (%)
Excellent	>70	55	37.9
Very Good	60–70	31	21.4
Good	55–60	26	17.9
High Average	50–55	20	13.8
Below Average	<50	13	8.9
Total Sample	—	145	100.0

4.3 Gender-Based Fitness Comparisons. Independent t-test analysis revealed statistically significant gender differences in Physical Fitness Index ($t=2.84$, $df=143$, $p=0.005$). Male students demonstrated superior mean fitness (68.1 ± 15.8) compared to female counterparts (58.4 ± 14.2), representing 9.7-point absolute difference.

Gender-stratified fitness rating analysis indicated that 48.2% of male students achieved excellent ratings versus 29.2% of females. Conversely, 14.7% of females demonstrated below-average fitness compared to 4.6% of males.

Table 3. Physical Fitness Index Stratified by Gender and Academic Program

Group	N	Mean PFI	±SD	Range	p-value
Gender					
Male	65	68.1	±15.8	39–89	0.005
Female	80	58.4	±14.2	37–85	0.005
Program					
Physical Therapy	95	64.2	±15.9	37–89	0.142
Medicine	50	60.1	±14.6	38–82	0.010

4.4 Fitness Progression Across Academic Years. One-way analysis of variance documented significant fitness differences across academic year cohorts ($F=4.27$, $df=4,140$, $p=0.003$). First-year students demonstrated mean fitness of 58.3 ± 14.9 , second-year students 61.1 ± 15.4 , third-

year students 68.9 ± 13.2 , and fourth-year students 67.4 ± 14.8 . Integrated program participants exhibited intermediate fitness (62.1 ± 15.1). Pairwise comparisons indicated that third- and fourth-year cohorts achieved significantly superior fitness compared to first-year students ($p < 0.05$).

Table 4. Physical Fitness Index by Academic Year of Study

Academic Year	N	Mean PFI	±SD	Minimum	Maximum
First Year	49	58.3	±14.9	37	84
Second Year	18	61.1	±15.4	42	82
Third Year	8	68.9	±13.2	51	87
Fourth Year	26	67.4	±14.8	45	89
Integrated Program	44	62.1	±15.1	39	85
Total Sample	145	62.87	±15.33	37	89

4.5 Body Mass Index and Fitness Associations. Mean body mass index was 23.2 ± 2.8 kg/m² (range: 18.1–31.4). Pearson correlation analysis revealed significant inverse association between body mass index and Physical Fitness Index ($r=-0.421$, $p<0.001$), indicating that elevated body mass corresponded with reduced aerobic capacity measures. Students classified as normal weight (BMI 18.5–24.9) demonstrated superior fitness (mean PFI: 65.3 ± 14.1) compared to overweight cohorts (BMI ≥ 25.0 , mean PFI: 54.8 ± 15.7 , $p<0.001$).

5. Discussion

Results of this study suggest that around 62% of students in allied health had poor cardiorespiratory fitness while being in careers with high cardiovascular demands. These results are consistent with recent literature describing

alarming fitness gaps in medical and healthcare professional student groups. The high proportion (37.9%) with exceptional fitness ratings demonstrates that fitness capacity can still be attained in academic student groups, while the majority with below-average-to-good ratings indicates the necessity of regular fitness promotion programs. Gender-based disparities reported here, with female students having a 9.7-point lower mean Physical Fitness Index, mirror findings from international investigations and are likely reflective of a combination of biological and behavioral factors including differential physical activity engagement patterns and sociocultural exercise participation norms. This gradual increase in fitness from the early academic years through the third and fourth years warrants further investigation, possibly reflecting selective attrition of less-fit students,

improved maturity-related lifestyle changes, or differential academic scheduling allowing more exercise opportunities in the advanced clinical rotations. The inverse correlations between body mass index and aerobic fitness support existing physiological linkages, in which extra body weight decreases the efficiency of oxygen transport and raises metabolic needs for weight bearing activities (16). Identified modifiable characteristics, including patterns of physical activity, management of body composition, and involvement in structured exercise, point to possible potential for interventions in curriculum of health care education. Modern health care professional training is increasingly realizing that optimal personal fitness is a necessary for modeling healthy habits to patients and meeting performance demands over long careers. High-impact strategies to maximize cardiovascular preparation include mandated fitness screening, inclusion of exercise physiology curriculum and its implementation, and provision of institutional fitness facilities.

6. Conclusion

The mean cardiorespiratory fitness levels of allied health students were below optimal levels with significant differences noted between gender and year of study groups. The negative association between BMI and aerobic capacity in this study indicates a link between body composition and cardiovascular fitness. Comprehensive fitness promotion programs should be implemented at the institutional level, including formal exercise curriculum, readily available fitness facilities, and fitness screening protocols to improve cardiovascular readiness for the demands of clinical practice and foster healthy lifelong behaviors among emerging healthcare professionals.

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