RESEARCH ARTICLE

Association of body mass index, cardiorespiratory fitness, and their correlates among female physical therapy students in Multan

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Abstract

Objective: To explore the correlates directly associated with body mass index and cardiorespiratory fitness among undergraduate female physiotherapists.

Methods: The cross-sectional study was conducted from October to December 2020 at Ali-Ul-Murtaza Department of Rehabilitation Sciences, Muhammad Institute of Medical and Allied Sciences, Multan, Pakistan, and comprised undergraduate female physiotherapists aged17-25 years. The subjects were assessed on the basis of Physical Activity Readiness Questioner, body mass index and standard criteria of cardiorespiratory fitness. Data was analysed using SPSS 20.

Results: Of the 334 subjects with a mean age of 20.89±1.66 years, 200(59.88) were overweight and 34(10.17) were underweight. Overall 83(24.9) reported good quality of life, 194(58.1) were satisfied with their general health, and 228(68.3) presented with a history of cardiometabolic disorder. There was a highly significant positive correlation in overweight and negative correlation in underweight subjects ($p \leq 0.05$).

Conclusion: The frequency of overweight female physical therapy students was high.

Keywords: Cardiorespiratory fitness, Body mass index, Physical therapy students, Treadmill exercise, Shuttle-run test, Overweight, Stress inducers. (JPMA 72: 916; 2022)

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Introduction

The rising rates of obesity and cardiovascular disorders, especially in female university students, have become a global problem. A healthy cardiorespiratory system is necessary for having a good quality of life (QOL). A large-scale study on university students from 22 countries found a prevalence of overweight and obesity in several regions of the world ranging from 3% to 59%.[1]

The cardiac system supplies oxygenated blood to the whole body. Any type of fluctuation in any chamber of the heart causes a serious problem. A cardiac patient may have ailments, like hypertension (HTN), tachycardia, angina, blockage in any coronary artery, fibrillation, flutter, and myocardial infarction (MI). These aetiologies are directly linked to obesity.[2] There is a direct relationship between obesity and cardiovascular disorders (CVDs). The cause of obesity is the storage or collection of low-density lipoprotein (LDL) in the body that directly stimulate CVDs. The rate of obesity and overweight was particularly higher in university students.[1] Increase in the rate of cardiorespiratory disorders is directly proportional to the increase in body mass index (BMI) that has an inverse relation with QOL. BMI below the normal range in females means greater risk of osteoporosis, non-regulation in the menstrual cycle, and weak immunity.[2] Cardiorespiratory fitness (CRF) is the main component of physical fitness defined as 'ability of a body to perform dynamics, large-muscle exercise for a prolonged period at moderate to high intensity".[3] Normal CRF and bodyweight are necessary to have a good QOL. From college to university, the transition is the most difficult period accompanied by unfavourable weight-gain and decreased cardiovascular and muscular fitness due to unhealthy lifestyle and behaviour leading to poor QOL.[4]

CRF refers to the ability of the circulatory and respiratory systems to efficiently supply oxygen to the working muscle to sustain physical therapy.[5] CRF can be measured by using a variety of exercise models, such as treadmill, cycle ergo-meter, step test and running.[6,7]

In adult students, an increased rate of obesity, especially in university students, has become a global problem, affecting both the developing and the developed countries.[8] In Pakistan, the ratio of underweight and overweight was particularly high in university students.[9] In Pakistan, studies confirmed the presence of a significantly high rate of obesity/overweight in medical student as well as in the general population of Asia.[10,11] Studies showed that one in every four female undergraduates in Pakistan was Underweight.[12] Higher BMI was associated with an increased incidence of cardiometabolic disorders (CMDs).[9]

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On the other hand, females below normal BMI level have a high risk of osteoporosis, menstrual irregularities and weak immunity.[2]

CRF means that BMI and aerobic capacity are closely related to the risk of CMDss and negative health outcomes.[3] Oxygen consumption (VO2) is considered the most accepted parameter to measure maximum CRF capacity. Recent systematic reviews have shown a correlation between low QOL and negative health in university students.[13,14]

Physical therapy (PT) students, due to their nature of work, must have better CRF and overall health, but reports of low fitness in PT students and lack of emphasis on these topics at the entry-level PT curriculum have been noticed.[15] CVD, being the number one cause of death worldwide, refers to any disease that affects the cardiovascular system.[16] It was estimated that 175 million people died due to CVDs in 2012, representing 30% of all global deaths. Compared to obesity, the impact of CRF on human health has often been ignored, even though it appears to be one of the most important determinants of overall health status and a powerful predictor of CVD mortality and morbidity.[5,17]

The current study was planned to explore the correlation of BMI and CRF among female PT students.

Subjects and Methods

The cross-sectional study was conducted from October to December 2020 at Ali-Ul-Murtaza Department of Rehabilitation Sciences, Muhammad Institute of Medical and Allied Sciences, Multan, Pakistan. After approval from the institutional ethics review committee, the sample size was calculated using the Yamane formula[18] at 95% confidence level and 5% margin of error. The sample size was raised using non-probability convenience sampling technique. Those included were undergraduate female PT students aged 17-25 years. Those who were post-graduates, having any type of physical disability, having a history of chronic illness related to cardiorespiratory ailments, and those reporting with a history of chest pain, bronchitis and asthma were excluded.

After taking informed consent from the participants, they were subjected to the Physical Activity Readiness Questioner (PAR-Q), while QOL was measured using the World Health Organisation Quality of Life-Brief version (WHOQOL-BREF).[19]

Parameters were recorded by using mercury manometer, thermometer, pulse oximeter, Wrist-wearable bioelectrical impedance analyzer, and stethoscope.

BMI was calculated using the standard formula, and WHO guidelines for South Asian population were followed (under weight BMI less than 18.5, normal 18.5-22 and overweight a BMI up to 22.9 while obesity was considered with a BMI greater than or equal to 23).[20] Diagnostic Scale BG55 (Beurer Germany)[21] were used to estimate percent body fat (overweight (BF% 27.1-32%), and obese (BF% > or=32.1).

Further, exercise-induced stress tests were performed under the supervision of a woman medical officer and senior physiotherapist. A 20-metre shuttle run test was used for measuring CRF. Participants ran from one corner to another 20m apart while keeping pace with a pre-recorded beep.[22] When a participant failed to maintain the pace, the test was stopped. The number of shuttles was recorded. Blood pressure (BP), heart rate (HR), rate of respiration (RR), oxygen saturation (VO2-max) and temperature were noted before and after exercises.

For the treadmill test, the speed of the treadmill in the beginning was 88 m/min with 0% elevation. After the first minute, the elevation of the treadmill was increased to 2% and then after every minute, it was increased 1%. At the end of 25 minutes, the elevation remained at 25% but after every minute, the speed was increased by 5.4m.[19] Treadmill time has been shown to highly correlate with a direct measure of maximal oxygen uptake in women.[22] The subjects were encouraged by the instructor to give their maximal effort during the test, and those who could not achieve 85% of age-predicted HR were excluded.[19]

Objective measures of data collection, such as HR, BP, RR, VO2-max, and temperature were calculated through these stress-inducers.[9] VO2-max was determined with the formula:

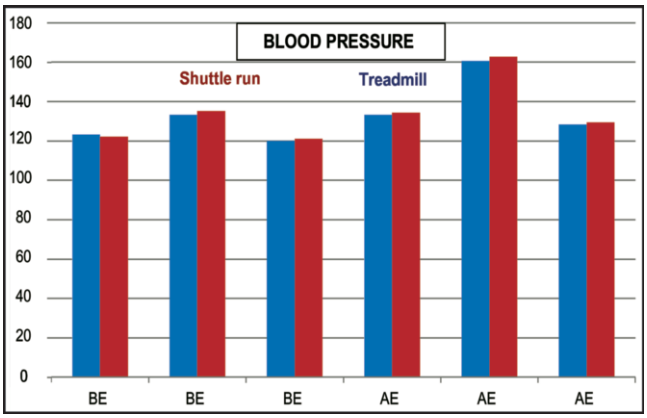
$$VO2\ max = HR\ max \times SV\ max \times (a\text{-}VO2\ difference)\ max.$$[23]

After exercise, the temperature was expected to increase up to 1°C in the participants which was to normalise after attaining homeostasis.[24]

Data was analysed using SPSS 20. Descriptive statistics, such as frequencies and percentages, were used to evaluate the characteristics of each participant for categorical variables, and mean and standard deviation (SD) for continuous variables. Pearson's correlation coefficient was used to determine association between the values of continuous variables and Spearman's correlation coefficient for ordinal variables. $P<0.05$ was considered statistically significant.

Results

Of the 334 subjects with a mean age of 20.89±1.66 years,



BEN: Before exercise in normal weight, BEO: Before exercise in overweight, BEU: Before exercise in underweight, AEN: After an exercise in normal weight, AEO: After exercise in overweight, AEU: After an exercise in underweight.

Figure-1: Fluctuation in blood pressure (BP) before and after a 20-meter shuttle-run test and treadmill test.

BEN: Before exercise in normal weight, BEO: Before exercise in overweight, BEU: Before exercise in underweight, AEN: After an exercise in normal weight, AEO: After exercise in overweight, AEU: After an exercise in underweight. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Figure-2: Fluctuation in heart rate (HR) before and after a 20-meter shuttle-run test and treadmill test.

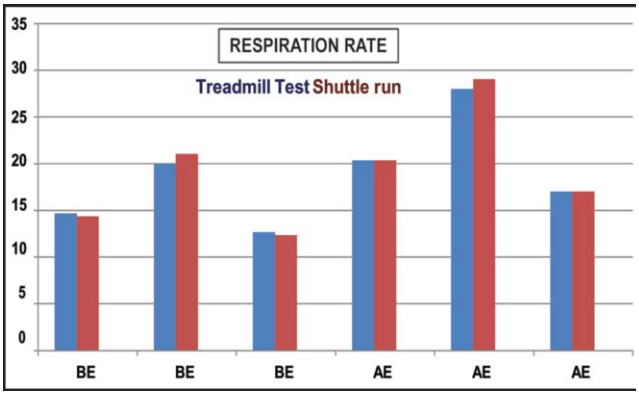


Figure-3: Fluctuation in respiratory rate (RR) before and after a 20-meter shuttle- run test and treadmill test.

Table-1: Demographic, health and anthropometric characteristics of the participants (n=334).

Variables	n%
Year of study	
1st year	47 (14.1)
2nd year	55 (16.5)
3rd year	108 (32.3)
4th year	76 (22.8)
5th year	48 (14.4)
Socioeconomic background	
Rural	148 (44.3)
Urban	186 (55.7)
Regular tea/coffee consumption	
Yes	108 (32.3)
No	226 (67.7)
Family history of cardiometabolic disorders (CMDs)	
Yes	228 (68.3)
No	106 (31.7)
Daily physical activity (150minutes/week)	
Yes	83 (24.9)
No	251 (75.1)
Subjective quality of life	
Very poor	14 (4.2)
Poor	24 (7.2)
Neither poor nor good	184 (55.1)
Good	83 (24.9)
Very good	29 (8.7)
Satisfaction with health	
Very dissatisfied	20 (6.0)
Dissatisfied	39 (11.7)
Neither dissatisfied nor satisfied	61 (18.3)
Satisfied	194 (58.1)
Very satisfied	20 (6.0)
Anthropometric indices	**Mean±SD**
Weight (kg)	52.76±10.20
Height (cm)	156.41±5.14
BMI (kg/m^2)	21.57±4.10
	n%
Underweight	34 (10.17)
Normal weight	100 (29.94)
Overweight	200 (59.88)
Obese	0 (0)

BMI: Body mass index, SD: Standard Deviation.

200(59.88) were overweight and 34(10.17) were underweight. Overall 83(24.9) reported good QOL, 194(58.1) were satisfied with their general health, and 228(68.3) presented with a history of CMDs (Table-1).

BP, HR, RR and VO2-max values were noted after each test and on each count there was significant correlation with overweight (Table-2; Figures-1-3).

Table-2: Cardiorespiratory parameters in correlation with demographic, anthropometric and physical fitness components.

	Mean	Standard deviation	p-value
RR of the treadmill test			
Normal	21.00	3.60	
Overweight	28.00	1.00	0.007
Underweight	17.33	2.51	
BP of the treadmill test			
Normal	126.66	2.88	
Overweight	146.66	5.77	0.001
Underweight	123.33	2.88	
HR of the treadmill test			
Normal	81.33	4.04	
Overweight	146.66	20.81	0.001
Underweight	76.33	5.13	
VO2 max of Treadmill			
Normal	94.33	1.15	
Overweight	98.66	0.57	0.000
Underweight	92.00	0.00	
RR of shuttle-run Test			
Normal	18.00	2.00	
Overweight	25.66	1.15	0.001
Underweight	18.33	0.57	
BP of shuttle-run test			
Normal	126.66	2.88	
Overweight	146.66	5.77	0.001
Underweight	123.33	2.88	
HR of shuttle-run test			
Normal	86.66	2.88	
Overweight	141.66	2.88	0.000
Underweight	81.66	3.51	
VO2 max of shuttle-run			
Normal	94.33	1.15	
Overweight	98.66	0.57	0.000
Underweight	92.00	0.00	

	1	2	3	4	5
Age	0.435**	-	-	-	-
BMI	0.067	0.386**	-	-	-
VO2-max	-0.079	0.807	-0.97*	-	-
Quality of life	-0.583	0.582	0.440	-0.52*	-
Health satisfaction	0.07	0.013	-0.028	-0.05	0.567**

RR: Respiratory rate, HR: Heart rate, BP: Blood pressure, VO2-max: Maximal oxygen consumption.

Discussion

The current study found a significant negative correlation between BMI and subject's QOL. The majority of participants in the sample size were overweight on the basis of BMI, and recent studies from Pakistan and Asia support the finding,[10,17] suggesting that the rising trend was due to a sedentary lifestyle, socioeconomic shift, unhealthy food choices, lack of physical activity, and sleep changes.[12,13] The mechanism behind this effect may be that due to muscle work, glucose is utilized and lactic acid is formed, demanding more oxygen to clear the oxygen debt, causing rise in RR and this demand of adenosine triphosphate (ATP) causes the stimulation of sympathetic system of autonomic nervous system, releasing noradrenaline from sympathetic nerve endings and adrenaline from the adrenal glands.[3] These stimulates β1 receptors, causing cardio-acceleration.[5] When biochemical energy is converted to mechanical energy, conversion rate is up to 30%, and the remaining energy is dissipated in the form of heat, causing rise in body temperature, which, in turn, causes the activation of sweat glands releasing the water as sweat on the body surface.[9] The vaporisation of sweat causes cooling of the body surface to maintain the temperature at 37°C.

The current study used standardised protocols and validated tools which has increased its validity. Future studies on CRF and body mass composition should be conducted with larger and multi-centre samples with subjects from different educational backgrounds.

Conclusion

The prevalence of overweight in undergraduate female PT students was high. Physiotherapy students are expected to have a high level of CRF because of the nature of their work, but CRF in overweight female students was below the acceptance level.

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Conflict of Interest: None.

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