RESEARCH ARTICLE

Association of body mass index, cardiorespiratory fitness, and their correlates among female physiotherapy students in Nawabshah

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Abstract

Objective: To explore the association of body mass index with cardiorespiratory fitness and other health correlates among physiotherapy students.

Methods: This cross-sectional study was conducted from February to July 2018 at the Peoples University of Medical and Health Sciences for Women, Nawabshah, Pakistan, comprising female undergraduate physiotherapy students aged 17-25 years. All the eligible participants were assessed using a self-report questionnaire, body mass index, and standardised cardiorespiratory fitness criteria. SPSS 20 was used for data analysis.

Results: There were 228 subjects with a mean age of 20.89±1.66 years. Of the total, 77(33.8%) students were overweight/obese and 52(22.8%) were underweight. Overall, 212(93%) reported good quality of life, and 189(82.9%) were satisfied with their general health. Also, 180(79%) subjects had a post-exercise heart rate below average. There was a significant negative correlation for body mass index and maximum oxygen uptake, body mass index and age, and maximum oxygen uptake and subjective quality of life ($p<0.05$ each).

Conclusion: The frequency of both overweight/obesity and underweight physiotherapy undergraduates was high.

Keywords: Aerobic capacity, Cardiorespiratory fitness, Obesity, Physiotherapy students, Quality of life.

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Introduction

The rising rate of obesity in adults, particularly university students, has become a global problem, affecting both developed as well as developing countries.[1,2] A recent large-scale study on university students from 22 countries found that prevalence of overweight and obesity in several regions of the world ranges from 3% to 59%.[1] The rates of overweight/obesity and underweight were particularly high in Pakistani university students.[1] In Pakistan, studies using the cut-offs for Asian population have found significantly higher rate of overweight/obesity in medical students and in the general population.[3-5] On the other hand, studies have found that one in every four female undergraduates in Pakistan is underweight.[4,6]

Body mass index (BMI) is considered a relatively easy and commonly used measure to assess body composition. Evidence suggests that higher BMI is associated with increased incidence of cardiometabolic disorders (CMDs), decreased life expectancy, and certain types of cancers.[4,7,8] On the other hand, below-normal BMI is linked with a wide array of disorders.[8] Especially in females, it increases the risk of menstrual irregularities, weak immunity, and osteoporosis.[9]

Cardiorespiratory fitness (CRF), also referred to as aerobic capacity, and BMI are closely associated with the risk of CMDs, all-cause mortality, and negative health outcomes.[10,12] CRF is one of the most important components of physical fitness and is defined as the "ability of the body to perform dynamic, large-muscle exercise, for prolonged periods, at moderate-to high intensity".[10] Maximum oxygen consumption, or maximal aerobic capacity (VO_{2max}), is considered the most widely accepted measure of functional capacity of the cardio-respiratory system, or the oxygen transport system, giving a baseline estimate of one's heart and lung capacity.[10-12] Although sophisticated laboratory equipment is required for the direct measurement of VO_{2max}, its most commonly

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used indirect method includes exercise protocols such as the Three-Minute Step Test (TMST).[10]

Normal body weight and good CRF are essential to have a good quality of life (QOL). Recently conducted systematic reviews have found lower QOL scores and negative health correlates in university students.[13,14] Transition from college to university is a critical period accompanied by unfavourable weight changes and decreased cardiovascular and muscular fitness due to unhealthy lifestyle behaviours, leading to adverse health outcomes and deteriorating QOL.[15] Thus, examination of these factors in university students is important from a public health perspective.

Existing evidence suggests that there is an inverse relationship between BMI and CRF.[10,15] However, data exploring association of BMI with CRF and other correlates, especially from Pakistan, are limited.[10,16] Specifically, physiotherapy students, due to the nature of their work, have to have better CRF and overall health, but reports of low fitness in physiotherapy students and a lack of emphasis on these topics at the entry-level physiotherapists' curriculum has been noticed.[17] To the best of our knowledge, no study from Pakistan has been conducted to determine an association of BMI with CRF and other health correlates in physiotherapy students. The current study was planned to explore this association in university-level physiotherapy students.

Subjects and Methods

This cross-sectional study was conducted from February to July 2018 at the Peoples University of Medical and Health Sciences for Women, Nawabshah, Pakistan. After approval was obtained from the institutional ethics committee, Letter No: PUMHSW/IPRS/ORS: 318), the sample size was calculated using the Raosoft[18] calculator. A minimum of 208 subjects were required at the confidence level of 95% and margin of error being 5%.[18] The sample was raised using non-probability convenience sampling, and those included were female undergraduate physiotherapy students aged 17-25 years. Those excluded were known cases of physical or mental disabilities and chronic illnesses, individuals with a history of medications or a major surgery related to the study, subjects who had recently participated or were part of any physical conditioning programme, and pregnant or lactating women.

In accordance with the American College of Sports Medicine's guidelines for exercise testing and prescription, the eligibility of students was further confirmed by asking them to complete the Physical Activity Readiness Questionnaire (PAR-Q), a simple questionnaire consisting of questions such as chest pain, bone or joint problem, dizziness and loss of balance etc. in order to ensure the complete health status of the participants.[19,20] An affirmative answer to any of the questions meant exclusion of the individual concerned.

The data-collection instrument consisted of two parts. The first part was a self-report questionnaire asking about age, year of education, marital status, socioeconomic background (domicile and annual income), grade point average (GPA) etc., and the first two questions from the World Health Organisation Quality of Life-Brief (WHOQOL-BREF).[21] The first question, "How would you rate your quality of life?", was ranked on a 5-point Likert scale (Very poor=1 to Very good=5). The second question, "How satisfied are you with your health?", was also scored on a 5-point Likert scale (Very dissatisfied=1 to Very satisfied=5).

The second part of the data collection included objective measures such as height, weight, BMI, heart rate (HR), and blood pressure (BP). The body weight was measured with the subject wearing light clothing and without shoes, to the nearest 0.1kg with a digital scale. The height was measured to the nearest 0.1cm, with the participant standing erect on flat floor against a vertical scale, without shoes, and heels touching the wall. BMI was calculated by dividing weight in kilograms by height in meters squared and classified using the BMI cut-offs for Southern and Eastern Asian region.[22]

CRF was measured through TMST,[10] a simple method for measuring the HR response to stepping at a fixed rate and/or a fixed step height or by measuring post-exercise recovery HR. The test uses a 16.25-inch-high bench, a stopwatch, and a metronome with a stepping rate of 22 steps per minute for 3 minutes. After the completion of stepping, the study participants were immediately asked to sit down and the HR was counted for 15 seconds, starting within 5 seconds at the end of the exercise. The participants were asked not to perform vigorous exercise 24 hours before and not to take food, caffeine or to smoke two hours prior to the testing. Post-exercise recovery HR was used in the equation: [VO_{2max} (ml/kg/min) = 65.81 - (0.1847*pulse rate beats/min)], to determine the subject's maximal oxygen consumption.[23] The higher values of VO_{2max} were indicative of better cardiorespiratory health.

Table-1: Demographic and health characteristics of the participants (n=228).

Variable	Mean±SD	n (%)
Age (years)	20.89±1.66	
GPA	3.16±0.56	
Year of study		
1st year		44 (19.3)
2nd year		45 (19.7)
3rd year		43 (18.9)
4th year		47 (20.6)
5th year		49 (21.5)
Socioeconomic background		
Rural		97 (42.5)
Urban		131 (57.5)
Regular coffee consumption		
Yes		25 (11.0)
No		203 (89.0)
Regular tea consumption		
Yes		192 (84.2)
No		36 (15.8)
Family history of cardio-metabolic diseases		
Yes		129 (56.6)
No		99 (43.4)
Daily physical activity (150 minutes/week)		
Yes		101 (44.3)
No		127 (55.7)
Parental physical activity (150 minutes/week)		
Yes		95 (41.7)
No		133 (58.3)
Subjective quality of life		
Very Poor		-
Poor		4 (1.7)
Neither poor nor good		12 (5.3)
Good		168 (73.7)
Very good		44 (19.3)
Satisfaction with health		
Very dissatisfied		1 (0.4)
Dissatisfied		20 (8.8)
Neither satisfied nor dissatisfied		18 (7.9)
Satisfied		167 (73.3)
Very satisfied		22 (9.6)

GPA: Grade Point Average

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

There were 228 subjects with a mean age of 20.89±1.66 years. Of the total, 131(57.5%) participants had an urban background, 192(84.2%) were regular tea consumers, 129(56.6%) had a family history of non-CMD afflictions, 127(55.7%) did not perform recommended level of physical activity of 150 minutes/week, 133(58.3%) reported lack of recommended level of physical activity in parents, 212(93%) reported good QOL, and 189(82.9%) were satisfied with their overall health (Table 1).

Table-2: Anthropometric and Cardiorespiratory fitness characteristics of the participants (n=228).

Variable	
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	52 (22.8)
Normal weight	99 (43.4)
Overweight	57 (25.0)
Obese	20 (8.8)
Cardiorespiratory fitness	**Mean±SD**
Resting Heart Rate (beats/minute)	87.40±8.88
Post-exercise Heart Rate (beats/minute)	125.93±18.53
Resting Systolic (mmHg)	109.92±9.38
Post-exercise Systolic BP (mmHg)	128.04±14.66
Resting Diastolic (mmHg)	70.87±8.07
Post-exercise Diastolic BP (mmHg)	73.88±9.76
VO_{2max} (ml/kg/min)	42.55±3.42
Post-exercise VO_{2max}	**n (%)**
Excellent	3 (1.3)
Good	3 (1.3)
Above Average	16 (7.0)
Average	26 (11.4)
Below Average	31 (13.6)
Poor	47 (20.6)
Very Poor	74 (32.5)
Unacceptable	28 (12.3)

BMI: Body mass index; VO_{2max}: Maximum oxygen uptake; SD: Standard Deviation

The mean BMI of the subjects was 21.57±4.10 kg/m^2, with 77(33.8%) being overweight/obese and 52(22.8%) underweight. The mean VO_{2max} of the sample was 42.55±3.42 ml/kg/min, with 180(79%) having a post-

Table-3: Correlation of demographics with anthropometric and physical fitness components.

	1	2	3	4	5	6
1. GPA	-	-	-	-	-	-
2. Age	0.335**	-	-	-	-	-
3. BMI	0.056	0.285**	-	-	-	-
4. VO_{2max}	-0.063	0.034	-0.147*	-	-	-
5. Quality of life[b]	-0.059	0.112	0.077	-0.143*	-	-
6. Health satisfaction[b]	0.066	0.012	-0.028	-0.044	0.367**	-

GPA: Grade point average; BMI: Body mass index; VO_{2max}: Maximum oxygen uptake; *significant at p<0.05; **significant at p<0.01, [b]Spearman's correlation

exercise HR below average (Table 2).

A significant positive correlation was found between age and GPA ($p<0.001$), BMI and age ($p<0.001$), and between subjective QOL and satisfaction with health ($p<0.001$). A significant negative correlation was observed for VO_{2max} and BMI ($p=0.027$), and between VO_{2max} and subjective QOL ($p=0.03$)(Table 3).

Discussion

Medical students are in their period of transition from adolescence to adulthood and from college to university life. This transition is accompanied by unhealthy lifestyle behaviours due to lack of parental supervision, unhealthy dietary habits, low level of physical activity, sleep deprivation, and study-related stress.[13-15] Such a transition leads to changes in body compositions and overall health. The current study found a significant negative correlation of VO_{2max} with BMI and subjective QOL. Although BMI was positively associated with subjective QOL, it was not significant enough to allow reasonable conclusions ($p>0.05$). One-third of the participants were overweight/obese, with almost one in every four female students being underweight. CRF in terms of post-exercise HR was below average in more than three-fourth of the students.

Regarding BMI, 33.8% students in the current study were overweight and obese. These findings are supported by recently published studies from Pakistan and other Asian countries.[10,24-26] However, it was lower than several other studies in medical and physiotherapy students from other parts of the world.[10,15,17,27,28] The difference might be attributed to the difference of population characteristics, lifestyle behaviours, and difference in the cut-offs used for categorising BMI. According to a recent systematic review, obesity prevalence among young adults of developing countries ranged 2.3-12%, and being overweight accounted for 28.8%, mostly affecting females.[29] The rising rates of overweight and obesity in female students are partly due to socioeconomic shift, promoting sedentary behaviours due to excessive screen use, unhealthy obesogenic food choices, sleep changes, and lack of physical activity. Additionally, the period of shift from adolescence to adulthood and transition from college to university itself is accompanied by unfavourable weight changes and decreased cardiovascular and muscular fitness due to unhealthy lifestyle behaviours, leading to adverse health outcomes and deteriorating QOL.[15]

A striking finding in the study was that 22.8% participants were underweight. A study found that 27.2% female medical students were underweight and a recent study reported underweight status in 22% female students in Karachi.[4,10] In a large-scale study, the prevalence of underweight in female university students was 17.6%.[1] Studies from India, Malaysia, China and Bangladesh have found similar trends in female university students.[17,24,25,30,31] Underweight status in females is getting increasingly common due to the media campaigns of "thin ideals", and increases the risk of menstrual irregularities, weak immunity and osteoporosis;[9] thus, this target age group in universities should be educated about the nutritional requirements of this age.

In the current study, 78% participants had CRF below average. These findings are similar to the previous reports from India, Pakistan and Nepal.[10,16,32,33] Previous evidence suggests that majority of the women compared to men have lower level of CRF due to physiological factors and because of sedentary lifestyle behaviours.[10,12] The reasons attributed to sedentary behaviours in females may be the lack of access to exercise facility, social norms and safety issues. According to a study about body composition, fitness status and health behaviours in female university students, cardiovascular fitness was the only key health-related variable that was significantly correlated with anthropometric indices.[15] The current study found a significant negative correlation for VO_{2max} and BMI. Similar findings were reported in previous studies exploring association between BMI and CRF measured through VO_{2max}.[10,12,27] Moreover, evidence is suggestive of an association of the variables of CRF and anthropometric indices with academic performance.[27] One study reported a positive association between GPA and BMI;[34] which was similar to the current study, but the findings were not significant enough to draw reasonable conclusions. Another important finding was that VO_{2max} was negatively associated with subjective QOL. This finding raises the issue of misinterpretation and misunderstanding of students while reporting QOL.

To the best of our knowledge, this is the first study from Pakistan to assess an association of BMI with CRF and other health correlates among physiotherapy students in a university of the province of Sindh, Pakistan. However, there are some limitations to the study. Firstly, the sample was limited to one medical university and one gender

only. Secondly, QOL was assessed through self-reporting measures, which might have led to the reporting bias. Thirdly, TMST has its own limitation of accuracy in measuring CRF and that sophisticated measures, such as the cycle ergometry, were not used for a more in-depth assessment of endurance. Moreover, anthropometric indices were limited to BMI only, limiting detailed analysis of body composition. Nonetheless, we used standardised protocols and validated tools instead of using self-structured surveys, which increases the validity of the current findings. Future studies on the association of body composition with CRF and other health correlates with larger sample size from different educational programmes are recommended.

Conclusion

The burden of overweight/obesity as well as underweight was high in physiotherapy undergraduates. Due to the nature of their work, physiotherapy students are expected to have normal anthropometric indices and higher level of CRF. Although students assumed that they had a good QOL, their CRF was below the acceptable level.

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