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Impact of adolescent obesity on cardiorespiratory fitness parameters and anthropometry: A prospective study for reducing cancer risk in young adults

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ABSTRACT

Background: Sedentary lifestyles and poor physical fitness among young adults have become global health concerns, increasing the risk of obesity and related metabolic disorders. Adolescent obesity has been linked to reduced cardiorespiratory fitness, which may contribute to long-term health complications, including an increased susceptibility to cardiovascular diseases, metabolic disorders and certain types of cancer. Understanding the relationship between anthropometric measures and cardiorespiratory fitness can provide valuable insights into these risks and aid in the development of preventive strategies.

Methods: This cross-sectional study was conducted at Trichy SRM Medical College Hospital & Research Center, including 148 healthy students aged 17 to 23 years. Anthropometric parameters such as height, weight, BMI, waist circumference and waist-to-hip ratio were recorded. Cardiorespiratory fitness was assessed using the Modified Harvard Step Test, which calculates the Physical Fitness Index and VO_2 max based on pulse rate recovery. Statistical analysis was performed using SPSS, with t-tests and Pearson's correlation.

Results: Males exhibited significantly higher PFI and VO_2 max values compared to females ($p<0.001$). A statistically significant relationship was observed between BMI and PFI ($p=0.001$), with participants in the healthy BMI range (18.5-24.9) demonstrating better fitness. Obese individuals showed significantly lower fitness levels, reinforcing the negative impact of excess body weight on cardiorespiratory endurance. Given the established link between obesity, inflammation and increased cancer risk, the findings highlight the need for early interventions to mitigate these risks.

Conclusion: Adolescent obesity is associated with reduced cardiorespiratory fitness and unfavourable anthropometric measures, which may contribute to the development of chronic diseases, including cancer. Early lifestyle interventions focusing on weight management and regular physical activity are crucial for improving long-term health outcomes. Given the rising prevalence of obesity, educational institutions and policymakers must prioritize awareness and fitness programs to promote healthier lifestyles and reduce the long-term burden of obesity-related diseases.

Keywords: Cardiorespiratory fitness; Anthropometry; Adolescent obesity; Physical fitness index, VO_2 max; Cancer risk; Young adults

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INTRODUCTION

In recent times, the global trend towards sedentary lifestyles has raised concerns regarding the overall health and well-being of individuals, particularly among young adults. The increasing dependence on modern technology, the prevalence of desk jobs and the rise of screen time have collectively contributed to a reduction in physical activity. Young adults, in particular, often lead busy and stressful lives, managing academic, social and work-related responsibilities. Consequently, they tend to spend a significant amount of time engaged in sedentary lifestyle such as sitting for long duration during studies, commuting or spending time on electronic gadgets.

Young adults are at an important stage in their lives, with many leading a sedentary lifestyle that will affect their long-term health. The lifestyle choices made during this phase will have profound effects on their future possibility of developing obesity, cardiovascular and metabolic problems. Understanding the factors that influence physical fitness in this population is essential, not only for promoting healthier behaviors but also for improving academic and mental performance [1].

Cardiorespiratory fitness has been identified as a crucial parameter of health status. Good cardiorespiratory fitness has been associated with reduced mortality, better mental health and improved quality of life [2]. Poor fitness and adolescent obesity is associated with long-term health risks like diabetes mellitus, hypertension and increased susceptibility to cancer [3]. As a result, it is imperative to understand how anthropometric measurements are related to cardiorespiratory fitness.

Anthropometric measures have long been used as indicators for assessing the risk of developing metabolic diseases, as they provide valuable insights into the body composition. Body Mass Index assesses whether an individual has a healthy body weight corresponding to their height. BMI only takes into account height and overall weight, it does not consider the muscle weight and also the pattern of fat distribution. As a result, more comprehensive metrics such as waist-to-hip ratio and body fat percentage are often used along with BMI to give a better picture of an individual's overall health.

One of the major challenges in addressing physical fitness issues in young adults is the lack of motivation and awareness. In spite of having knowledge regarding the benefits of physical activity, many young adults struggle to incorporate exercise into their daily routines due to reasons such as shortage of time, social pressures or unawareness about the benefits of exercise. Studies have shown that doing some physically activity significantly benefits our mental health along with improving cardiovascular health [4,5].

In this context, understanding how physical fitness parameters are related with anthropometry can provide important insights for developing health interventions. A better understanding of how these variables are related will help healthcare professionals, educators and lawmakers to devise strategies to improve the overall wellbeing of young adults.

We aimed to explore the relationships between anthropometric measures, cardiorespiratory fitness and physical fitness index among adults. The primary goal was to assess the influence of BMI, waist circumference and other body measurements on physical fitness and cardiorespiratory endurance.

MATERIALS AND METHODS

Study design

Our study was a cross-sectional study conducted at Trichy SRM Medical College Hospital and Research Center, Irungalur, over a duration of one year. Institutional ethics committee approval was taken before the commencement of the study. Informed consent was taken from the participants.

Subjects: The participants included young male and female students aged 17 to 23 years.

We included subjects who were not receiving any medical therapy that could possibly affect cardiorespiratory function and who had a baseline resting blood pressure below 140/90 mm Hg.

Professional athletes, Subjects with respiratory, cardiac and other chronic diseases were excluded from the study. The final sample size consisted of 148 students, calculated using Open epi software.

RESULTS

Data collection

After thorough general physical examination, anthropometric parameters like, height, weight, BMI, waist circumference and hip circumference were recorded. Pulse rate and systolic and diastolic blood pressure, were recorded using standard procedures. Waist-to-Hip ratio was calculated by dividing WC by HC.

Cardiorespiratory fitness was assessed using the modified Harvard step test, which calculates the physical fitness index based on exercise duration and pulse rate recovery. The test involves stepping up and down a 33 cm high platform once every two seconds for 1 minute, followed by pulse rate measurements at 1, 3 and 5-minute intervals. The formula for PFI is:

Cardiopulmonary fitness parameters

The test is done on the modified Harvard steps of 33 cm height.

Physical Fitness Index (PFI in %): The test is done on the modified Harvard steps of 33 cm height and it is calculated using following formula:

PFI=(Duration of exercise in sec/(2 × Sum of pulse counts during recovery)) × 100

Maximal aerobic power (VO_2 max): Pulse rate recovery was used as a proxy for VO_2 max. It is obtained by using the formula:

For males: VO_2 max=111.33-(0.42 × Pmax)

For females: VO_2 max=65.81-(0.1847 × Pmax)

P max: maximum pulse rate/min recorded immediately after 60 sec of Harvard's step test exercise [6].

Statistical analysis and results

The t-test was performed to compare the means between the participants, while *Chi-square* tests were used to assess categorical variables. Pearson's correlation was used to determine relationships between anthropometric and fitness parameters. A p-value of <0.05 was considered significant (Table 1).

Tab. 1. Comparison of anthropometric parameters and physical fitness index between male and female subjects.

Variable	Mean ± SD		T test	P value
	Male	Female		
Age (yrs)	18.51 ± .89	19.08 ± 1.04	-3.56	<0.001
Height (m)	163.18 ± 4.85	158.24 ± 3.42	7.177	<0.001
Weight (kg)	61.32 ± 12.83	57.16 ± 14.39	1.87	0.063
BMI (kg/m^2)	23.23 ± 5.17	22.8592 ± 5.65	0.425	0.672
Physical Fitness Index (PFI) %	54.68 ± 29.82	43.8045 ± 29.10	2.26	0.025
VO_2 max	94.76 ± 2.64	58.56 ± 0.99	111.775	<0.001
Duration of exercise in seconds	166.94 ± 85.73	132.02 ± 81.57	147.14	0.012

Independent samples test

There was a significant difference in mean age, height, VO_2 max, duration of exercise and PFI between male and female subjects.

The results show significant differences in mean age, height, VO_2 max, PFI and duration of exercise between male and female participants. Males had better physical fitness as measured by PFI and VO_2 max compared to females. Height was also significantly greater among males, while BMI did not show a significant difference between genders (Tables 2 and 3).

Tab. 2. Mean values of physical fitness index of the subjects according to PFI category.

PFI category	PFI %		Total n (%)
	Male (74)	Female (76)	
<= 50: Poor, n (%)	41 (27.3)	47 (31.3)	88 (58.7)
51-60: Average, n (%)	9 (6)	12 (8)	21 (14)
61-70: Good, n (%)	4 (2.7)	4 (2.7)	8 (5.3)
71-80: Very good, n (%)	8 (5.3)	3 (2)	11 (7.3)
81-90: Excellent, n (%)	4 (2.7)	2 (1.3)	6 (4)
>90-Superb, n (%)	8 (5.3)	8 (5.3)	16 (10.7)

Tab. 3. Relationship between BMI and PFI.

BMI	PFI %						P Value
	<=50: Poor (88)	51-60: Average (21)	61-70: Good (8)	71-80: Very good (11)	81-90: Excellent (6)	>90-Superb (16)	
<18.5, n %)	17 (19.3)	11 (52.4)	0 (0)	0 (0)	0 (0)	6 (37.5)	0.001
≥ 18.5 to <25, n (%)	41 (46.6)	8 (38.1)	5 (62.5)	4 (36.4)	6 (100)	8 (50)	
≥ 25, n (%)	15 (17)	2 (9.5)	3 (37.5)	3 (27.3)	0 (0)	0 (0)	
≥ 30, n (%)	15 (17)	0 (0)	0 (0)	4 (36.4)	0 (0)	2 (12.5)	

There difference in the distribution of PFI categories between male and female participants, was not significant.

The relationship between BMI and PFI is statistically significant. Subjects with BMI values in the healthy range (18.5-24.9) showed better physical fitness outcomes compared to those with higher BMI values. The lowest PFI values were observed among participants with BMIs below 18.5 or above 30.

DISCUSSION

Our study shows that males exhibit higher levels of physical fitness than females, as indicated by the Physical Fitness Index (PFI) and VO_2 max values. These results are in accordance with research done earlier which show that males tend to have superior cardiovascular fitness compared to females [7,8]. These differences are likely attributed to physiological differences between the sexes, such as muscle mass, fat distribution and hormonal influences. Testosterone, for instance, promotes muscle growth and may contribute to better overall physical performance in males, especially in endurance activities [9]. Conversely, higher body fat percentages in females might impact their overall fitness levels, as excess fat tissue can negatively influence cardiorespiratory performance [10,11].

The significant gender-based differences in VO_2 max observed in our study align with earlier research that has established VO_2 max as a reliable predictor of cardiovascular fitness. VO_2 max is directly correlated with the efficiency of the cardiovascular system, reflecting how well oxygen is transported to and utilized by the muscles during physical exertion. Studies have shown that VO_2 max varies with exercise, genetic makeup, age and gender [6,12]. While males generally have higher VO_2 max values due to higher muscle mass and hemoglobin concentrations, females can achieve similar fitness levels through regular training and physical activity [9].

The relationship between BMI and physical fitness observed in this study reinforces the notion that maintaining a healthy weight is crucial for optimizing cardiorespiratory fitness. Those with BMI in the optimal range (18.5 to 24.9) had significantly better physical fitness scores, as measured by PFI and VO_2 max (Table 3). On the other hand, individuals with low BMI or high BMI (indicating underweight or obesity) demonstrated lower physical fitness. This aligns with findings from multiple studies that have shown that both low body weight and obesity are associated with lower fitness levels and poorer cardiovascular health outcomes [13-15].

BMI is critiqued for not considering variations in body composition, such as the proportion of muscle versus fat [16]. This highlights the importance of using other measurements, such as waist circumference, waist-to-hip ratio and body fat percentage, to assess the physical fitness. Measures like WC and WHR are important for assessing visceral fat, considered to be more dangerous to cardiovascular health compared to subcutaneous fat [17,18].

Our study's use of the modified Harvard step test to measure PFI is a reliable and practical approach for assessing cardiorespiratory fitness in large populations, particularly in resource-limited settings where more expensive equipment and facilities may not be available. The modified Harvard step test provides valuable insights into cardiovascular endurance without the need for complex equipment, making it a valuable tool for health screenings [19]. The test also helps assess the ability of an individual's cardiovascular system to recover after exertion, which is an important factor in determining overall fitness levels [20,21].

The findings of our study also emphasize the need for a multifaceted approach to improving physical fitness among young adults. It is not enough to focus on just one aspect, such as weight management or exercise; rather, a combination of healthy eating, regular physical activity and education on the importance of physical fitness should be promoted. Studies have shown that young adults who engage in regular physical activity have better physical health, improved academic performance and enhanced mental well-being [21]. As such, universities, schools and policymakers should prioritize initiatives that encourage physical activity and educate students on its importance.

The main limitation of our study is that it is a cross sectional study. Longitudinal studies that track changes in body composition and fitness over time are needed to analyze the chronic impact of lifestyle behaviors on health outcomes [22,23].

CONCLUSION

Our results show that both anthropometric parameters and cardiorespiratory fitness measures, such as PFI and VO_2 max, are closely linked. Regular physical activity, a balanced diet and proper weight management are essential components of a healthy lifestyle. Adolescent obesity is associated with compromised cardiorespiratory fitness and altered anthropometric parameters, which may contribute to an increased risk of developing chronic diseases, including cancer. Early interventions targeting weight management and physical fitness are essential to mitigate these long-term health consequences. Given the increasing levels of sedentary behavior among young adults, it is imperative that educational institutions and policymakers emphasize the importance of physical activity.

Future research should further explore the long-term effects of physical fitness on health outcomes and find ways to improves fitness. By relating physical fitness and anthropometry, strategies can be developed to improve the overall well-being of young adults. Regular physical activity enhances the immune system and diminishes inflammation, which aids in cancer prevention. Engaging in consistent exercise also promotes maintaining a healthy weight, thereby decreasing the likelihood of developing cancer and associated metabolic disorders

REFERENCES

1. Piscaglia F, Lencioni R, Sagrini E, Dalla Pina C, Cioni D, et al. Characterization Powell KE, Blair SN. The public health burdens of sedentary living habits: Theoretical but realistic estimates. Med Sci Sports Exerc. 1994; 26:851-816.
2. Hruby A, Hu FB. The epidemiology of obesity: A big picture. Pharmacoeconomics. 2015; 33:673-689.
3. Ortega FB, Lavie CJ, Blair SN. Obesity and cardiovascular disease: Pathophysiology, evaluation and effect of weight loss. Circ Res. 2018; 122:1752-1770.
4. Munagekar AU, Likhite A. Comparison of Physical Fitness Index (PFI) between spinning (indoor cycling) female practitioners and Zumba female practitioners using modified Harvard's step test: a pilot study. Int J Phys Res. 2021; 9:3800-3807.
5. Pate R, Oria M, Pillsbury L. Youth Fitness: Measurement, Interpretation and Interventions. National Academy Press; 2012.
6. Pareek KK, Narsimulu G. Medicine Update 2019 and Progress in Medicine 2019. Jaypee Brothers Medical Publishers; 2019; 31.
7. Nabi T, Rafiq N, Qayoom O. Assessment of cardiovascular fitness (VO_2 max) among medical students by Queens College step test. Int J Biomed Adv Res. 2015; 6:418-421.
8. Raghuveer G, Hartz J, Lubans DR, Takken T, Wiltz JL, et al. Cardiorespiratory Fitness in Youth: An Important Marker of Health: A Scientific Statement from the American Heart Association. Circulation. 2020; 142:101-118.
9. Albouaini K, Egred M, Alahmar A, Wright DJ. Cardiopulmonary exercise testing and its application. Heart. 2007; 93:1285.
10. McArdle WD, Katch FI, Katch VL. Essentials of exercise physiology. Lippincott Williams & Wilkins. 2006.
11. Rzewnicki R, Auweele YV, de Bourdeaudhuij I. Sociocultural and psychological determinants of physical activity in young adults: A review. Int J Sports Psychol. 2003; 34:335-348.
12. Gohar Z, Mirza M. Effect of regular physical activity on body mass index and physical fitness of young adults in Karachi. J Pak Med Assoc. 2018; 68:1367-1371.
13. Sarioglu S, Alhuwailah A, Alan G. Relationship between body mass index and physical fitness in young adults. Int J Sports Med. 2019; 40:401-416.
14. Cunningham DA, Bouchard C, Poehlman ET, Skinner JS. The study of physical activity and its effects on cardiovascular fitness. Med Sci Sports Exerc. 1991; 23:261-268.
15. World Health Organization. Obesity: Preventing and managing the global epidemic: Report of a WHO consultation. 2000.
16. Kim J, Cho Y, Lee Y, Jung Y. The effect of waist-to-hip ratio on physical fitness in adolescents. Obes Res Clin Pract. 2015; 9:134-140.
17. Beavers KM, Wylie-Rosett J. Obesity: A serious health risk in young adults. J Clin Endocrinol Metab. 2019; 104:1-11.
18. Liu Y, Wang X, Su M, Li Y. Association between body mass index and physical fitness in a young population in China. Public Health Nutr. 2017; 20:430-439.
19. Dumith SC, Hallal PC, Reis RS, Kohl III HW. Worldwide prevalence of physical inactivity and its association with human development index in 76 countries. Prev Med. 2011; 53:24-28.
20. Manthena M, Ramesh B. Relationship between BMI and Physical Fitness in College Students. Indian J Physiol. 2020;65:234-240.
21. Singh S, Marwah S, Nayak P. Association between body composition and physical fitness parameters in young adults: An observational study. J Appl Physiol. 2018; 124:654-660.
22. Mahar MT, Rowe DA, Kleykamp BA, McElroy M. The relationship between BMI, body fat percentage and physical fitness. Res Q Exerc Sport. 2016; 87:261-266.
23. Samad M, Hassan K, Alam A, et al. Assessment of physical fitness among students: A cross-sectional study of Karachi university. Pak J Physiol. 2019; 15:21-26.