Research Article

Cardiorespiratory Fitness between Physically Active and Inactive Obese Medical Students

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Background & objectives: Physical inactivity is a well-known factor for cardiometabolic risk among children and adolescents that can be assessed by Cardiorespiratory Fitness (CRF). However, there is a paucity of research on CRF in obese medical students who face academic pressures and lifestyle challenges. The present study aimed to compare CRF between physically active and inactive obese medical students using the Six-Minute Walk test (6MWT).

Methods: A cross-sectional comparative study, which enrolled 72 obese medical students (BMI ≥ 25 kg/m^2) categorised into physically active (46) and inactive (26) groups based on Metabolic Equivalent of Task (MET) score assessed by Global Physical Activity Questionnaire. All participants underwent 6MWT according to the standardized guidelines of the American Thoracic Society. Blood pressure and heart rate were measured at baseline and after 6MWT, and VO2max was calculated. Data were analysed using an independent t-test and linear regression, with $p < 0.05$ statistically significant.

Results: Weekly physical activity levels measured by MET were markedly higher in the physically active obese group ($p = 0.0001$), with non-significantly higher estimated VO_{2max} compared to inactive obese following 6MWT. Blood Pressure and heart rate showed a non-significant difference. Linear regression analysis showed a significant positive relationship between 6MWD and VO_2max, in active obese students, 6MWD accounts for about 11% variability in VO_2 max (r = 0.3323, $p = 0.024$) and in inactive obese, nearly 52% (r = 0.7183, $p = 0.001$).

Interpretation & Conclusions: The cardiorespiratory fitness of obese adolescent was similar irrespective of their physical activity status, suggesting obesity may override the effect of physical activity in young age.

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Introduction

According to the WHO Physical Activity Profile 2022 for India, the prevalence of physical inactivity among adults aged 18 years and above is 25% for males and 44% for females.[1] Physical inactivity is associated with reduced cardiorespiratory fitness in obese young adults.[2] Cardio-respiratory fitness (CRF) is a crucial aspect of health, requiring the combined functioning of the circulatory, respiratory, and muscular systems to deliver oxygen to active tissues during physical activity.[3]

As per WHO recommendations on physical activity for health, throughout a week, including activity for work, during transport and leisure time, adults should do.[4]

- At least 150 minutes of moderate physical activity (like brisk walking) OR
- At least 75 minutes of vigorous physical activity (like running) OR
- An equivalent combination of moderate and vigorous-intensity physical activity achieving at least 600 Metabolic Equivalent of Task (MET) minutes.

Recent global projections published in The Lancet (2025) estimate that by 2050, more than half of the world's adults may be overweight or obese, highlighting obesity as a rapidly growing public-health concern and excess adiposity can reduce exercise tolerance, increase cardiovascular load, and impair ventilatory efficiency, thereby worsening CRF.[5] Previous surveys in Indian medical colleges had reported a substantial burden of overweight and obesity. A comprehensive meta-analysis

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of 99 studies encompassing 47,455 medical students reported a pooled prevalence of 18 % for overweight and 9% for obesity, with a combined excess weight prevalence of 24%.[6]

The 6-minute walk test (6MWT) provides valuable insights into an individual's cardio-respiratory fitness and is a submaximal field test for exercise assessment, widely used in clinical settings. It is universally accepted as a safe, simple, and inexpensive test that does not require sophisticated or costly equipment.[7,8]

Medical students often adopt a sedentary lifestyle due to long study hours, a shortage of time for physical activity and self-care, and high stress levels.[9,10] Despite being aware of the well-documented benefits of physical activity, many medical students struggle to integrate regular exercise into their routines, while some efficiently manage to meet daily physical-activity requirements.[11] While numerous studies have explored cardio-respiratory fitness in general populations, there is a paucity of research specifically focusing on medical students.

The present study aimed to assess cardio-respiratory fitness of obese medical students by comparing physically active and inactive individuals using the 6-minute walk test.

Material & Methods

Study Design

A cross-sectional comparative study was conducted from February 2025 to November 2025 after ethical approval (Ref No: 202MC/EC/2024 Dated 29/01/2025) from the Institutional Ethical Committee, and informed consent was obtained from all the subjects.

Study Participants

A total of 72 obese medical students (aged 18–26 years) pursuing first-year MBBS of the institute, who fulfilled the WHO Asia-Pacific[12] classification for obesity (BMI of 25 kg/m^2 or higher), were included in the study, irrespective of sex. Participants with any acute/chronic disease, cardiopulmonary disease, hypertension, endocrine disorder, diabetes, musculoskeletal illness, physical handicap, or history of smoking/alcohol consumption were excluded.

Study Tools

Global Physical Activity Questionnaire (GPAQ)

Is a tool designed by the World Health Organization (WHO) to measure the individual physical activity people do in their daily lives[13]. Consisting of 16 questions, assesses physical activity in three domains:

- Activity done at work, including jobs, chores, and farming.
- Travel between places, such as walking or cycling.
- Recreational activities like sports or exercise.

The questionnaire also gathers information about duration of sedentary behaviour, how much time a person spends sitting or inactive.

The energy is measured by METs, or Metabolic Equivalent of Task. Based on the Metabolic equivalents values (MET) obtained from GPAQ, the participants (72 obese medical students) were divided into two groups.

- Physically Inactive Obese (PIO) (n=26), who had less than 600 MET minutes per week.
- Physically Active Obese (PAO) (n=46), who had 600 MET minutes per week or more.

Six-Minute Walk Test (6MWT) for assessing cardio-respiratory Fitness

The Six-Minute Walk test (6MWT) was conducted in accordance with the American Thoracic Society (ATS) standardized guidelines, under the supervision of the Chief Investigator[7,8]. Participants performed the test on a flat, unobstructed 30-meter walkway marked by two coloured cones placed at each end. They were instructed to walk back and forth between the cones for a total duration of 6 minutes at a steady pace, without running or jogging. Participants were allowed to slow down or pause briefly if they experienced discomfort; they were encouraged to resume walking as soon as they felt capable, such participants were excluded from the study. The test was terminated precisely at 6 minutes, and the total distance covered was documented.

Anthropometric factors and the outcomes of the 6MWT were used to calculate the estimated VO_{2max}, considered as the best indicator of CRF by the World Health Organization[14], using equation formulated by Burr et al. as follows[15]:

VO_{2max} (ml/kg/min) = 70.161 + (0.023 × 6MWT [m]) – (0.276 × weight [kg]) – (6.79 × sex, where male = 0, female = 1) – (0.193 × resting HR [beats per minute]) – (0.191 × age [y])

Hemodynamic Parameters

Blood Presssure and Heart Rate were measured at baseline and after 6MWT. Systolic and diastolic blood pressure were measured using a standardized mercury sphygmomanometer with all necessary precautions.

Statistical Analysis

The data were presented as Mean ± Standard Deviation (SD). Data analysis was performed using SPSS version 26.0 (IBM SPSS Statistics for Windows, IBM Corp., Armonk, NY). The Shapiro-Wilk test results showed a normal distribution for all outcome variables (p>0.05). Consequently, the quantitative data were analysed using independent unpaired t-tests and qualitative variable was analysed using the chi-squared test. Correlation between 6-minute walk distance (6MWD) and VO_{2max} was analysed by linear regression analysis. Statistical significance was set at p-values < 0.05.

Results

The present study was conducted on 72 participants to compare the cardiorespiratory fitness between physically inactive and active obese medical students. All socio-demographic parameters, including age, gender, height, weight and BMI did not differ significantly between the two groups, which depicts the comparability between the two groups. The only parameter that differed significantly was the weekly MET score, which was markedly higher in the PAO group compared to the PIO group (p = 0.0001), confirming clear variation in activity levels between the two categories (Table-1).

Blood pressure and heart rate did not differ significantly between the PIO and PAO groups both at baseline and after 6MWT. However, the mean change in blood pressure was more among PAO group compared to PIO though non-significant. With respect to heart rate, mean change was more in PIO again non-significant (Table 2).

All participants successfully completed 6MWT, with no need for breaks or experiencing any interruptions during the test. However, the PAO group exhibited a non-significantly higher mean VO_{2max} value compared with the PIO group (Table 3).

Linear regression analysis showed a significant positive relationship between 6MWD and VO_{2max} in both groups. In active obese students, the regression equation was $VO_{2max} = 0.0154 \times 6MWD + 29.85$ with a low coefficient of determination ($R^2 = 0.1105$), indicating that 6MWD explained about 11% of the variability in VO_{2max} ($r = 0.3323$, $p = 0.024$). In inactive obese students, the equation $VO_{2max} = 0.0433 \times 6MWD + 14.388$ showed a higher explanatory power ($R^2 = 0.516$), with 6MWD accounting for nearly 52% of VO_2 max variability ($r = 0.7183$, $p = 0.001$) (Figure 1).

Discussion

The present study compared cardio-respiratory fitness between physically active and inactive obese medical students using the Six-minute Walk test and observed that PAO students had non-significantly higher VO_{2max} values as compared to the PIO despite comparable anthropometric and baseline haemodynamic profiles. The 6MWD is positively associated with VO_2 max in both active and inactive obese medical students, with a moderate relationship in inactive subjects. This suggests that the cardiorespiratory fitness of obese adolescent was similar irrespective of their physical activity status.

Despite having differences in weekly MET minutes between groups, the comparable cardiorespiratory fitness in physically inactive and physically active obese young adults can be explained by the fact that CRF is influenced by various modifiable factors such as dietary patterns, socioeconomics, including habitual physical activity[3]. Ruiz et al reported that the strength of the association between habitual physical activity and CRF in youth is small to moderate, with most of the benefits accruing

Table 1: General sociodemographic characteristics of medical students

Parameters	*Physically Inactive Obese (n=26) (Mean ± SD)*	*Physically Active Obese (n= 46) (Mean ± SD)*	*p-value*
Age (years)	19.61 ± 1.52	19.54 ± 1.54	0.853
Gender n (%)			0.18
Male	14 (54)	32 (70)	
Female	12 (46)	14 (30)	
Height (m)	1.67 ± 0.09	1.68 ± 0.08	0.628
Body weight (kg)	76.8 ± 12	81.31 ± 12.41	0.138
BMI (kg/m^2)	27.36 ± 2	28.16 ± 3.1	0.241
MET (minutes/week)	294.61 ± 216.4	2920.86 ± 1794.48	0.0001*

(Data are represented as Mean ± Standard Deviation (SD), n= number of subjects, MET: Metabolic Equivalents of Task, *Statistically significant (p-value<0.05)

Table 2: Comparison of hemodynamic variables between physically inactive and active obese medical students

Parameters	*Physically Inactive Obese (PIO, n=26) (Mean ± SD)*	*Physically Active Obese (PAO, n= 46) (Mean ± SD)*	*p-value*
Systolic Blood Pressure (mmHg)			
Resting	130.26 ± 16.14	131.52 ± 15.66	0.803
After 6MWT	136.96 ± 14.42	141.50 ± 18.94	0.293
Mean Change	6.68 ± 12.96	9.98 ± 16.76	0.389
Diastolic Blood pressure (mmHg)			
Resting	75.23 ± 9.74	75.41 ± 11.66	0.505
After 6MWT	76.84 ± 9.50	79.67 ± 16.38	0.423
Mean Change	1.62 ± 8.92	4.26 ± 13.68	0.381
Mean Arterial Blood Pressure (mmHg)			
Resting	93.57 ± 10.44	94.12 ± 12.01	0.846
After 6MWT	96.88 ± 10.30	100.28 ± 16.47	0.345
Mean Change	3.30 ± 8.52	6.17 ± 13.76	0.339
Pulse Pressure (mmHg)			
Resting	55.03 ± 13.58	56.11 ± 11.30	0.719
After 6MWT	60.11 ± 10.25	61.83 ± 11.06	0.518
Mean Change	5.07 ± 12.80	5.72 ± 11.47	0.825
Heart rate (beat/min)			
Resting	87.07 ± 14.97	83.76 ± 17.27	0.629
After 6MWT	97.19 ± 17.65	93.07 ± 19.03	0.43
Mean Change	10.12 ± 8.21	9.30 ± 10.18	0.727

(Data are represented as Mean ± Standard Deviation (SD)), n= number of subjects, *Statistically significant (p-value<0.05)

only with sustained vigorous physical activity[16]. Another factor could be using a sub-maximal test rather than the gold standard method, which may not differentiate subtle aerobic differences in young adults, especially when obesity dominates functional capacity over activity level.

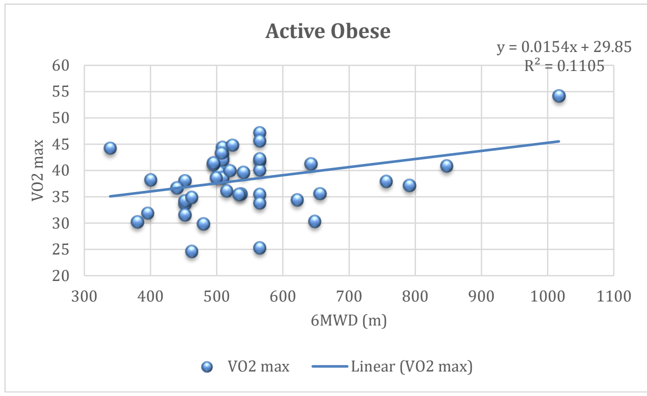
A recent study conducted by Jena SK on the cardiorespiratory fitness of medical students at a health institute in Eastern India revealed mean VO_{2max} values of 56.4 ± 4 mL/kg/min for males and 51.9 ± 6 mL/kg/min for females[17]. In contrast, the present study found lower VO_{2max} values in both obese groups, with 37.64 ± 5.30 for the physically active group and 38.19 ± 5.61 for the physically inactive group. This indicates that obesity diminishes the advantages of physical activity, regardless of activity level.

Obesity may reduce the positive effects of physical activity, so it is important to focus on managing weight to improve cardiorespiratory fitness in this vulnerable group of future healthcare providers. In medical students specifically, previous multicentre studies have shown that higher leisure-time physical activity is associated with better perceived health and quality of life, suggesting that active behaviour confers both physiological and psychosocial benefits in this group[11,18].

Table 3: Comparison of Six Minute Walk Distance and VO_{2max} between physically active and inactive obese medical students

Parameters	*Physically Inactive Obese (PIO, n=26) (Mean ± SD)*	*Physically Active Obese (PAO, n= 46) (Mean ± SD)*	*p-value*
Six Minute Walk Distance (m)	537.58 ± 88.10	541.17 ± 120.96	0.895
Estimated VO_{2max} at the end of 6MWT (ml/kg/min)	37.64 ± 5.30	38.19 ± 5.61	0.685

(Data are represented as Mean ± Standard deviation), *Statistically significant (*p-value* <0.05)



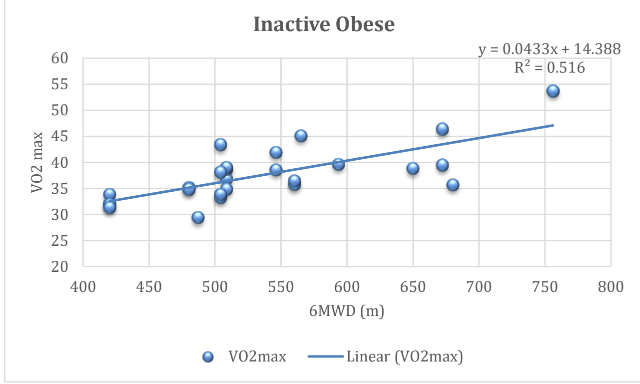


Figure 1: Linear regression of 6-meter walk distance with VO2 max among active and inactive obese medical students

Given the demanding academic environment and high prevalence of sedentariness reported among medical trainees, the present findings reinforce the need to prioritise structured physical activity (that are simple and sustainable) promotion in medical curricula[1,9,18].

Strength and Limitations of study

The study has several limitations that must be acknowledged. First, the sample size was modest and drawn from a single medical college, which may limit generalisability to medical students in other regions or institutions. Second, physical activity was assessed using a self-reported questionnaire, which is subject to recall and social-desirability bias and may misclassify some students' activity status. Third, VO_{2max} was calculated by formula instead of treadmill or cycle ergometer, which are gold standard methods.

Despite these limitations, the present study adds to the limited literature on cardio-respiratory fitness in obese medical students, a subgroup at risk of both academic stress and lifestyle-related non-communicable diseases.[2,3,9] By using the WHO Asia-Pacific BMI criteria and a validated physical-activity questionnaire, this study offers context-specific data that are relevant for this demographic cohort of the Asian population, who develop obesity-related complications at lower BMI thresholds.[19]

Conclusion

Six-minute Walk distance and VO_2 max did not differ significantly among obese groups depicting that the cardiorespiratory fitness of obese adolescent was similar, irrespective of their physical activity status. Thus, concluded that obesity may override the effect of physical activity at a young age. Further studies are needed to explore the role of physical activity and obesity on cardiorespiratory fitness, as age advances in adolescence cohort with a more advanced gold standard method for measuring CRF.

Recommendation

Obesity may obscure the advantages of physical activity on conventional fitness indicators, requiring personalized evaluation (e.g., accounting for lean mass or employing performance-specific metrics). Interventions should emphasize weight management and customized exercise programs to enhance functional capacity beyond conventional aerobic assessments.

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Conflict of Interest

None.

Ethical Clearance

Ethics Committee, SMS Medical College & Attached Hospitals, Jaipur, Ref No: 202MC/EC/2024 Dated 29/01/2025

Data Sharing Statement for All Original Research

Data is with us; it will be shared as and when required

Declaration of Artificial Intelligence (AI) in Scientific Writing

The authors declare that no AI-assisted technology was used in the preparation of this manuscript, and all images are original and have not been manipulated using AI tools.

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