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Correlation of peak expiratory flow rate (PEFR) to body mass index (BMI) in physiotherapy students

Simran Patil[1], Satish Pimpale[2], Pranjal Grover[3]
[1] TMV's Lokmanya Tilak College of Physiotherapy, Kharghar, Navi Mumbai, Maharashtra, India
[2] Head of Department of Neuro-Physiotherapy, TMV's Lokmanya Tilak College of Physiotherapy, Kharghar, Navi Mumbai, Maharashtra, India
[3] Professor and Principal, TMV's Lokmanya Tilak College of Physiotherapy, Kharghar, Navi Mumbai, Maharashtra, India

Abstract
Body Mass Index and Peak Expiratory Flow Rate are important measures of body composition and lung function. Physical exercise has been shown to influence both parameters; however, the relationship between the two among physiotherapy students is unknown. The purpose of this correlational study was to establish the relationship between Body Mass Index and Peak Expiratory Flow Rate among undergraduate physiotherapy students, as well as to compare Peak Expiratory Flow Rate values between exercising and non-exercising individuals, which were defined using the International Physical Activity Questionnaire. 150 subjects were evaluated for Body Mass Index (weight/height²) and Peak Expiratory Flow Rate (peak flow meter). The data were evaluated with Spearman correlation and Mann-Whitney U tests. The results showed that there was no statistically significant link between Body Mass Index and Peak Expiratory Flow Rate ($p > 0.05$), and there were no significant differences between the exercising and non-exercising groups. These findings indicate that Body Mass Index alone may not predict pulmonary function in physiotherapy students. Factors like respiratory muscle strength and general fitness could have a bigger impact.

Keywords: Body mass index, peak expiratory flow rate, International Physical Activity Questionnaire, undergraduate physiotherapy students

Introduction

Respiratory health is a key component of overall well-being and is heavily influenced by a variety of physiological, environmental, and lifestyle factors. Body composition and physical fitness are two of the most important factors in predicting pulmonary function. The respiratory system maintains homeostasis by delivering oxygen to tissues and removing CO2 through proper breathing and gas exchange. Lung function changes can have a negative impact on physical performance, exercise tolerance, and overall quality of life. In this context, Peak Expiratory Flow Rate (PEFR) is widely recognized as a simple, reliable, and non-invasive measure of pulmonary function, reflecting the calibre of airways and expiratory muscle strength [9]. On the other hand, Body Mass Index (BMI), a commonly used anthropometric index, reflects the relationship between an individual's weight and height and serves as an indicator of nutritional status, adiposity, and risk of cardiometabolic diseases. The peak expiratory flow rate (PEFR), which measures how much air a person can forcibly exhale in a single, rapid breath, is a crucial and accurate way to evaluate lung function [1]. Body Mass Index (BMI), is a simple weight-for-height index that is frequently used to categorize adults who are overweight or obese [4]. PEFR and BMI are significant measures of total health that are impacted by a number of variables, such as degree of physical activity and respiratory muscle strength [2]. Physiotherapy students, being part of the healthcare profession, are expected to maintain good health and physical fitness.

Students who lead sedentary lives and engage in less physical activity may have an impact on their weight and general health. There is a correlation between increased physical exercise and decreased health risk. Independent of food and physical exercise habits, there is evidence linking high levels of sedentary behaviour, such as watching television, using computers, and spending a lot of time sitting still for work or study, to an increased risk of obesity [6].

Obesity-related respiratory disorders are one of the main health issues, particularly for young adults [1]. The thoracic cavity's vertical diameter may decrease as a result of the truncal fat compressing the cavity and limiting diaphragmatic movement. These modifications could make the thoracic cavity and lungs less compliant and put more strain on the respiratory muscles. As a result, lung volumes and flow rates—particularly PEFR—may decline [4]. Due to decreased diaphragmatic mobility and respiratory muscle activity, underweight individuals have impaired respiratory function [2].

The thoracic cavity's compliance, airway resistance, respiratory muscle strength, and the lungs' elastic recoil all play a role in determining pulmonary functions. It is commonly known that physical attributes such as age, height, and body weight can affect pulmonary functions. One such metric that is simple to measure with a peak flow meter and useful for assessing lung function in a field study is PEFR. It is thought to be a reliable sign of bronchial hyperresponsiveness and doesn't need to be corrected for body temperature pressure saturation [5].

Need of Study

The current study is to check the effect of change in body mass index on Peak expiratory flow rate in undergraduate physiotherapy students. The study is required to assess and correlate the PEFR to BMI in undergraduate physiotherapy

students by using peak flow meter. So, that it can help young generations to perform routine exercises to increase their respiratory efficiency.

Aim

This study aims to correlate the peak expiratory flow rate with body mass index in physiotherapy students.

Objective

1. To evaluate PEFR values in physiotherapy students according to their BMI.
2. To study the impact of BMI on lung function in physiotherapy students.
3. To correlate PEFR measurements and BMI values in undergraduate physiotherapy students.

Materials and Methods

In total, 150 undergraduate physiotherapy students from TMV's Lokmanya Tilak College of Physiotherapy participated in this correlational study. Convenient sampling was used to select participants, and their scores on the International Physical Activity Questionnaire (IPAQ) were used to separate them into two groups: those who exercised and those who did not.

Inclusion criteria

Students within the age group of 18-25 years.
Students studying in 1st (After 6 months), 2nd, 3rd, 4th year & Interns of Undergraduate Physiotherapy.
Including both male and female.
Subjects who were physically active and into fitness training under supervision with International Physical Activity Questionnaire (IPAQ) score considering Moderate category i.e. 3 or more days of vigorous activity of at least 20 minutes per day.
Subjects who did not engage in physical activity or receive fitness training under supervision with International Physical Activity Questionnaire (IPAQ) score considering Low category i.e. No activity is reported or some activity is reported but not enough to meet categories 2 or 3.

Exclusion criteria

Subjects with history of smoking.
Subjects with severe chest trauma.
Subjects with personal history of asthma, chronic obstructive pulmonary diseases and other cardiorespiratory diseases.
Subjects with Poly-Cystic Ovary Syndrome, Poly-Cystic Ovary Disorder, and thyroid disorders.

Outcome Measures

Asia Pacific scale: Validity: sensitivity- 67%, specificity- 54%.
International Physical Activity Questionnaire (IPAQ): reliability was very good (r, = 0.8).
Cipla breathometer (peak flow meter): Validity: sensitivity- 56%, specificity- 94% Measuring tape and Weighing scale.

Procedure

Approval was taken from the Institutional Ethics Committee of TMV'S Lokmanya Tilak College of Physiotherapy, kharghar.
The purpose and the procedure of the study was clearly explained to the participants and the informed consent was taken with consideration of inclusion and exclusion criteria. Those who were willing to participate was included in the study. Demographic data was taken.
The Participants was asked to fill the International Physical Activity Questionnaire (IPAQ). The Participants height and weight was measured and BMI was calculated and readings were noted down.
Subjects who are physical activity and into fitness training under supervision was consider as Group A. Subjects who are not physically active and not into fitness training under supervision was consider as Group B.
The demonstration of PEFR device was done to the participants and the participants performed the same procedure for 3 times to get the best result and highest result was recorded. (procedure was performed in standing position). The data is statistically analysed using Microsoft Excel.

Data Analysis and Results

Statistical Analysis

The statistical analysis was performed using Microsoft Excel. To describe the data, the mean, standard deviation, minimum, and maximum values of both BMI and PEFR were determined. Skewness and kurtosis scores were used to assess the normality of the data distribution. The findings indicated that BMI (skewness = 0.891, kurtosis = 1.081) and PEFR (skewness = 1.089, kurtosis = 1.289) were not normally distributed. Because of the non-normal distribution, non-parametric tests were chosen for further examination.
Spearman's rank correlation coefficient was used to calculate the association between BMI and PEFR. The study population was separated into two subgroups based on IPAQ scores: Group A (exercising students, n = 98) and Group B (non-exercising students, n = 52). The Mann-Whitney U test was used to assess differences across groups. All statistical tests were set with a significance level of $p < 0.05$.

Results

The study included 150 undergraduate physiotherapy students aged 18-25. The sample includes both male and female students. The descriptive statistics for BMI and PEFR are shown in Table 1. The subjects had a mean BMI of 24.97 ± 5.61, with a range of 15.6–46.3. The average PEFR was 307.86 ± 91.41 L/min, with a range of 130 to 580 L/min.
Because the data were not normally distributed, the correlation analysis using Spearman's rank correlation revealed that there was no significant relationship between BMI and PEFR in the entire sample (r = 0.022, p = 0.786) as shown in Table 2. When separated by physical activity level, Group A (exercising students, n = 98) demonstrated a weak positive but statistically non-significant connection between BMI and PEFR (r = 0.115, p = 0.259). Group B (non-exercising students, n = 52) demonstrated a slight negative and non-significant connection (r = -0.222, p = 0.114).

The Mann-Whitney U test was used to compare the Body Mass Index (BMI) and Peak Expiratory Flow Rate (PEFR) of undergraduate physiotherapy students who exercised (Group A) and did not exercise (Group B).

In the BMI comparison, the U statistic was 2738.0 with a p-value of 0.4542, showing no statistically significant difference between Group A and Group B. Group A had a total of 7589 ranks (mean rank = 77.44), whereas Group B had 3736 ranks (mean rank = 71.85). The projected total number of ranks for each group was 7399, with an average rank of 75.5. The obtained U-value was 2358, compared to an expected U-value of 2548. The estimated Z-score was 0.74834, with a p-value of 0.45326, indicating no significant difference at $p < 0.05$. There was no significant variation in BMI between active and non-exercising students.

For PEFR comparison, the U statistic was 2680.0 with a p-value of 0.6031, indicating no statistically significant difference between the groups. Group A had a total of 7531 ranks (mean rank = 76.85), while Group B had 3794 ranks (mean rank = 72.96). Each group's projected sum of ranks was 7399, with a mean rank of 75.5. The obtained U-value was 2416, which is slightly lower than the projected U-value of 2548. The estimated Z-score was 0.51929, with a p-value of 0.60306, indicating no statistical significance at $p < 0.05$. As a result, there was no significant difference in PEFR between exercising and non-exercising pupils.

Overall, the statistical analysis found no significant differences in BMI or PEFR between students who exercised regularly and those who did not exercised is shown in Table 3.

Table 1: shows the overall descriptive statistics for BMI and PEFR among undergraduate physiotherapy students

Variable	Mean ± SD	Minimum	Maximum
BMI	24.97 ± 5.61	15.6	46.3
PEFR (L/min)	307.86 ± 91.41	130	580

BMI: Body Mass Index, PEFR: Peak Expiratory Flow Rate, SD: Standard Deviation

Table 2: shows the correlation between BMI and PEFR in the overall sample and subgroups.

Group	Spearman's correlation coefficient (r)	p-value	Interpretation
Overall (n = 150)	0.022	0.786	Not significant
Exercising (n = 98)	0.115	0.259	Not significant
Non-exercising (n = 52)	–0.222	0.114	Not significant

BMI: Body Mass Index, PEFR: Peak Expiratory Flow Rate, n: Number of subjects

The scatter plot of overall BMI and PEFR (Chart 1.) shows the spread of values, with no evident trend or relationship between the two variables.

Table 3: shows the comparison between BMI and PEFR in Group A & Group B

Variable	U Statistic	Z-Score	p-value	Interpretation
BMI (kg/m²)	2738.0	0.74834	0.4542	Not significant
PEFR (L/min)	2680.0	0.51929	0.6031	Not significant

BMI: Body Mass Index, PEFR: Peak Expiratory Flow Rate

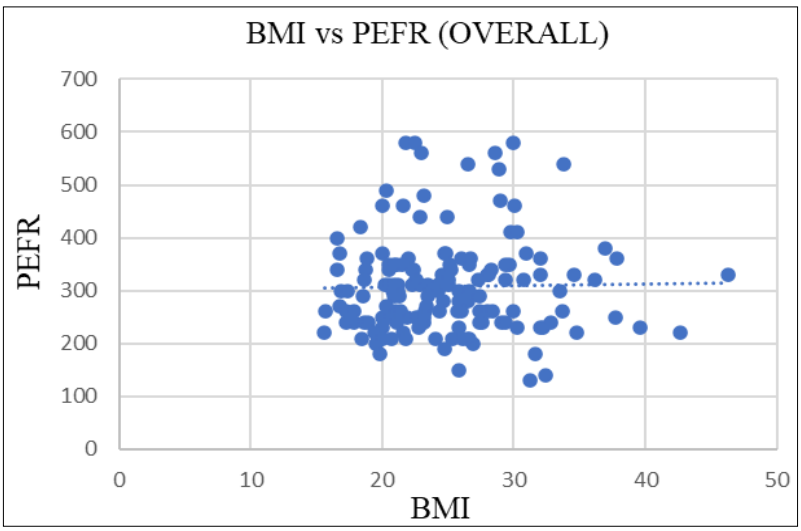

Chart 1: A scatter plot of the relationship between BMI and PEFR in undergraduate physiotherapy students

Scatter plots by group are shown in Chart 2. And Chart 3, respectively. In the exercising group (Chart 2.), the point distribution shows a weak positive trend, but in the non-exercising group (Chart 3.), the distribution shows a weak negative trend. However, neither were statistically significant.

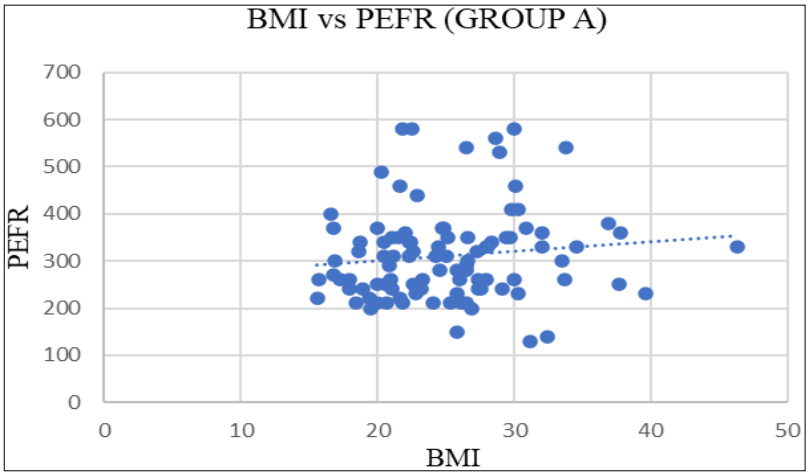

Chart 2: A scatter plot illustrating the relationship between BMI and PEFR in Group A (exercising students)

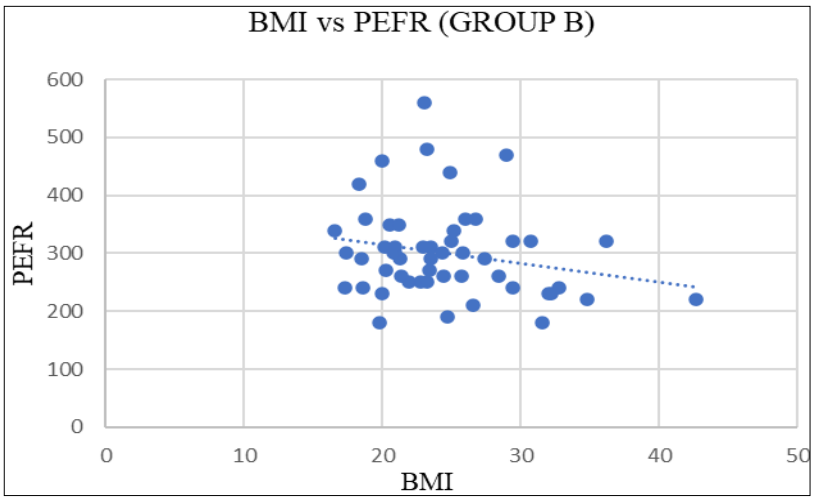

Chart 3: shows the scatter plot of the relationship between BMI and PEFR in Group B (non-exercising students)

Discussion

The current study aimed to look at the relationship between Body Mass Index (BMI) and Peak Expiratory Flow Rate (PEFR) among undergraduate physiotherapy students, as well as to compare PEFR values between exercising and non-exercising individuals.

In the current study, 150 undergraduate physiotherapy students, ages 18 to 25, had their body mass index (BMI) and peak expiratory flow rate (PEFR) recorded with a Cipla peak flow meter. Using the IPAQ scale to stratify the sample into exercising (Group A) and non-exercising (Group B) groups, the results revealed no significant relationship between BMI and PEFR. Additionally, no statistically significant correlation between BMI and PEFR was found when the Asian Pacific BMI criteria were used to classify the participants into underweight, normal, overweight, and obese categories.

The mean PEFR was 307.86 ± 91.41 L/min (range 130–580), while the mean BMI was 24.96 ± 5.60 (range 15.6–46.3). Overall, there was a very weak and statistically non-significant positive correlation coefficient (rs = 0.022) between BMI and PEFR. Non-significant results were also found in subgroup analysis, with Group A (students who exercised) exhibiting a weak positive correlation (rs = 0.1150) and Group B (students who did not exercise) displaying a weak negative correlation (rs = -0.2217). These results suggest that expiratory flow in this young, healthy population was not significantly impacted by changes in BMI.

Our results align with several research studies that found no significant relationship between young individuals' PEFR and BMI. Tiwari *et al.* (2023) [1] in Nepal found that while PEFR tended to decrease as BMI increased, the relationship was not statistically significant (r = -0.09), with height emerging as a more powerful predictor of PEFR [1]. Similarly, A small, non-significant correlation between BMI and PEFR was discovered by Gupta & Rai (2019) [4] among Indian college students, indicating that BMI by itself might not have an impact on expiratory flow in young, healthy populations [4].

Other research has found a negative relationship between BMI and PEFR. Jena *et al.* (2017) [5] found that rising BMI significantly decreased PEFR in both male and female young adults, with correlation values of r = -0.512 and -0.539 [5]. Similarly, Mistry and Pathak (2024) [2] observed that PEFR readings were found to be lower in obese young adults than in those with normal BMI, indicating potential respiratory restrictions caused by excess weight [2]. This suggests that excess adiposity may limit thoracic expansion, impairing pulmonary function [2]. However, such impacts were more noticeable in populations with a wider BMI range or a larger prevalence of obesity, whereas in our study, the majority of participants fell between normal and overweight, lowering the likelihood of discovering significant relationships.

The lack of significant findings in our study could be due to the homogeneous and healthy young group, with PEFR levels generally retained and BMI values clustered around normal to overweight ranges. Tiwari *et al*. (2023) [1] reported similar findings, seeing a restricted range in young medical students, which resulted in non-significant results [1]. Moreover, BMI is a crude index that does not distinguish between fat and lean muscle; among physiotherapy students, increased BMI may indicate muscle mass rather than adiposity, explaining the mild positive trend in exercisers and the negative trend in non-exercisers.

The data indicate that BMI alone is not a reliable predictor of PEFR in young, healthy persons, particularly in a student population with BMI ranges that are reasonably normal. Anthropometric characteristics such as height and chest size, as well as physical activity level, may be more important in determining expiratory flow. Maintaining a healthy weight with enough lean mass is critical for physiotherapy students not only for overall health, but also for achieving peak respiratory performance during academic and clinical activities.

Conclusion

This study discovered no significant relationship between BMI and PEFR among undergraduate physiotherapy students, implying that BMI is not a strong predictor of lung function in this population. Thus, these findings confirm the null hypothesis and show that BMI is not a reliable predictor of peak expiratory flow in young, healthy adults.

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