



Association of Peak Expiratory Flow Rate with Anthropometric Parameters among Medical Students: A Cross-Sectional Study

Anagha Ajitha Laiju^{*}, Dhanya Mavelithottathu Surendran, Anu Iomsa Elizabeth Joy, Shiny Iomsa George, Neenu Sunil Allenjerill

Department of Physiology, Azeezia Institute of Medical Sciences and Research, Kollam, Kerala, India

ARTICLE INFO

Article history:

Received 03 October 2025

Received in revised form 27 November 2025

Accepted 05 December 2025

Available online 10 December 2025

Keywords:

Body Mass Index

Peak Expiratory Flow Rate

Waist Circumference

Waist-Hip Ratio

ABSTRACT

Background and aim: Obesity is a growing health concern among children, adolescents, and young adults and is associated with an increased risk of several chronic diseases, including respiratory disorders. Anthropometric indices such as Body Mass Index (BMI), waist circumference, and Waist-to-Hip Ratio (WHR) are commonly used to assess overall and central obesity. This study aimed to evaluate the relationship between Peak Expiratory Flow Rate (PEFR) and anthropometric parameters, including height, weight, BMI, waist circumference, and WHR among medical students.

Material and methods: This cross-sectional study was conducted on 102 medical students. Anthropometric measurements, including height, weight, waist circumference, and hip circumference, were recorded, and BMI and WHR were calculated. PEFR was measured using Wright's peak flow meter. Participants were informed about the study procedures, and demonstrations were provided before data collection. Statistical analysis was performed using SPSS software, and Pearson's correlation coefficient was used to determine the association between PEFR and anthropometric variables.

Results: PEFR showed a positive correlation with height, indicating better pulmonary function among taller individuals. In contrast, weight, BMI, waist circumference, and WHR demonstrated negative correlations with PEFR. However, the association between WHR and PEFR was not statistically significant.

Conclusions: Anthropometric parameters significantly influence PEFR among medical students. Increased adiposity, particularly central obesity, may adversely affect respiratory function. These findings emphasize the importance of incorporating anthropometric assessments into respiratory health evaluations and promoting early lifestyle interventions to prevent obesity and preserve lung function in young adults.

1. Introduction

Obesity is a major global public health concern characterized by excessive accumulation of body fat that adversely affects health and well-being.^[1] The prevalence of obesity has increased markedly among children, adolescents, and young adults, particularly in developing countries such as India.^[2] Rapid changes in lifestyle, including unhealthy dietary habits, increased consumption of processed foods, reduced physical activity, and sedentary behaviors, have contributed substantially to this growing epidemic.^[3] Obesity is now recognized as an important risk factor for several chronic diseases, including respiratory disorders.^[4] Pulmonary function is influenced by body composition, and obesity can adversely affect respiratory mechanics by reducing chest wall compliance, limiting diaphragmatic movement, and increasing airway resistance.^[3] Body Mass Index (BMI) is the most commonly used anthropometric measure for assessing general obesity,

whereas waist circumference and waist-to-hip ratio (WHR) are considered important indicators of central obesity.^[5] In Asian populations, lower BMI cut-off values have been recommended because obesity-related health risks occur at lower BMI levels than in Western populations.^[5] Peak Expiratory Flow Rate (PEFR) is defined as the maximum expiratory flow achieved during a forceful expiration following full inspiration.^[6] It is a simple, inexpensive, and reliable measure of pulmonary function and is influenced by several factors, including age, sex, height, weight, body surface area, BMI, and ethnicity.^[7] Previous studies investigating the relationship between obesity and PEFR have produced inconsistent findings. Some studies have reported reduced pulmonary function and lower PEFR values in obese individuals, whereas others have shown either a positive association or no significant relationship between BMI and pulmonary function.^[8–10] These variations may be related to differences in age groups, ethnicity, patterns of

^{*} Corresponding author. Lazareth Liz Ortiz Santiago

E-mail address: lazarethsantiago2012@gmail.com

Department of Stomatology, University of Medical Sciences of Havana, Havana, Cuba

<https://doi.org/10.30485/IJSRDMS.2026.566775.1692>



fat distribution, and methods used to assess obesity. Among the anthropometric indices, WHR is considered a more sensitive indicator of central obesity than BMI and may better reflect obesity-related respiratory impairment.^[11] However, limited information is available regarding the association between WHR and PEFR, particularly among young adults and the South Indian population. Therefore, the present study was undertaken to evaluate the association between PEFR and anthropometric parameters, including height, weight, BMI, waist circumference, and WHR among medical students, and to assess the effect of central obesity on respiratory efficiency.

2. Material and methods

- Study Design: This research employs a cross-sectional study design to analyze data from a specific population at a single point in time.
- Study Setting: The study is conducted within the Department of Physiology at the Azeezia Institute of Medical Science and Research.
- Study Period: The entire duration of the research process is scheduled to span a period of six months.
- Study Population: The target population for this research consists specifically of medical students.
- Sampling Technique: A stratified random sampling technique is used to select participants, ensuring that various subgroups of the population are adequately represented.
- Inclusion Criteria: The study includes MBBS students who are willing to participate and have given their voluntary consent.
- Exclusion Criteria (Smoking): Students who have a history of smoking are excluded from participating in this study.
- Exclusion Criteria (Disease): Individuals with a known history of cardiac or pulmonary diseases are ineligible for the study.
- Exclusion Criteria (Surgery): Any student with a history of recent abdominal or thoracic surgery is excluded from the sample.
- Exclusion Criteria (Academic Phase): Medical students who are currently in Phase I of their studies are not included in this research.

Data collection tools and techniques

Ethical clearance was obtained from the institutional ethical committee (No.: AEC/APR/2025/28) prior to the start of the study. After obtaining written informed consent, the waist circumference is measured by wrapping a flexible, non-stretchable tape around the belly at the midpoint between the bottom of the ribs and the top of the hip (just above the umbilicus). Tape is pulled tight without digging into the skin and measured in centimeters. Measurement is taken three times to ensure accuracy and consistency. Hip circumference is measured around the widest part of the buttocks in inches, and the Waist-Hip Ratio is calculated.^[12] To measure height, students are asked to stand straight with the back, heels, and the back of the head touching the wall. Vertical distance from the bottom of the feet to the top of the head is measured in centimeters using a measuring tape. The students' weight will be measured in kilograms using a standardized weighing machine.^[13] BMI will be calculated using the Quetelet formula.^[14] Students were categorized into underweight, normal weight, overweight, and obese according to the consensus statement for the diagnosis of obesity in Asian Indians.^[15] PEFR will be measured using the Wright Mini Peak Flow Meter. An individual demonstration of the procedure is given. The values shown are noted, and PEFR was measured five times; the highest three readings were recorded for analysis.^[16]

3. Results

The study was conducted among 102 medical students, comprising 66 females and 36 males. The distribution of males and females is represented graphically in Fig. 1.

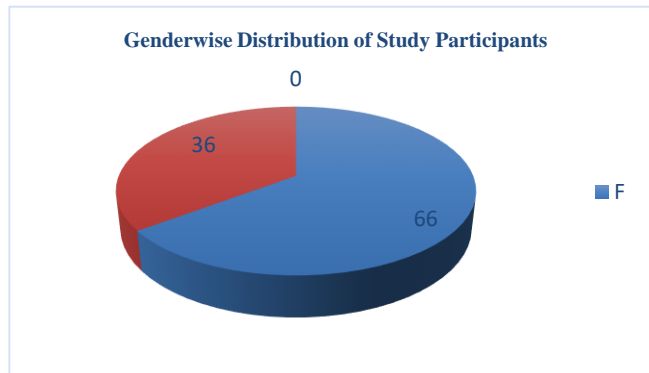


Fig. 1. Gender wise distribution of study participants.

Fig. 2. presents the gender-specific distribution of study participants by BMI classification. In the underweight category there were 27% males and 73% females. The overweight category included 42% males and 58% females. The obese category included 42% males and 58% females, while 29% males and 71% females were categorized under normal BMI.

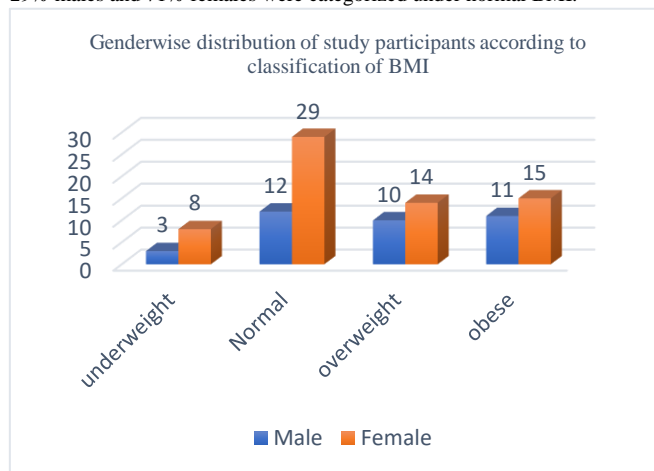


Fig. 2. Gender wise distribution of study participants according to the classification of BMI.

Among 102 medical students 11(10.78%) of them belongs to underweight category, 41(40.19%) belongs to normal weight, 24(23.5%) are overweight and 26(25.24%) were included under obese category. In the underweight category there were 3(27%) males and 8(73%) females. The overweight category included 42% (10) males and 58% (14) females. The obese category included 42% (11) males and 58% (15) females, while 29% (12) males and 71% (29) females were categorized as having normal BMI. (Fig. 2)

Table 1 presents the mean and standard deviation of anthropometric parameters, including height, weight, BMI, waist circumference, WHR, and PEFR, for the study population. The mean age of the study participants was 20 years.

Table 1. Average values of age, anthropometric parameters, and PEFR of the study population.

	N	Minimum	Maximum	Mean	Std. Deviation
Age	102	18	23	20.00	1.081
Height	102	147.0	185.0	163.005	8.8035
Weight	102	35	97	62.28	12.072
BMI	102	14.56	32.89	23.40	3.992
Waist Circumference	102	60	101	80.03	9.497
Waist HIP Ratio	102	0.72	1.03	0.85	0.06
PEFR	102	110	590	296.27	116.236

When we analyzed the descriptive statistics, the mean age of the study participants was 20 years. Mean height is 163 cms, and mean weight is 62 kg. Mean BMI is found to be 23.4. Waist circumference varies from 60 cms to 101 cms, with a mean of 80.3, and hip circumference varies from 72 cms to 102 cms. Mean waist-hip ratio is .85. When it comes to PEFR, the minimum PEFR is 110 and the maximum is 590, with a mean PEFR of 296.27

Table 2 shows the correlation between BMI and various anthropometric parameters. It shows a positive, statistically significant correlation between

PEFR and height. It also reveals a weak negative correlation between PEFR and weight, which is statistically significant (p value: 0.000). As weight increases, PEFR decreases. It shows that as BMI increases, PEFR decreases, indicating a statistically significant negative correlation between the two. (p value:0.000). There is a statistically significant negative correlation between PEFR and Waist circumference. (p-value:0.00) with a correlation coefficient of -.373.

Table 2. Correlation between PEFR and anthropometric parameters.

	PEFR	r-value	P-value
Height	Significant	0.509	0.000
Weight	Significant	-0.345	0.000
BMI	Significant	-0.397	0.000
Waist Circumference	Significant	-0.373	0.000
Waist HIP Ratio	Not Significant	-0.112	0.262

**. Correlation is significant at the 0.01 level (2-tailed).

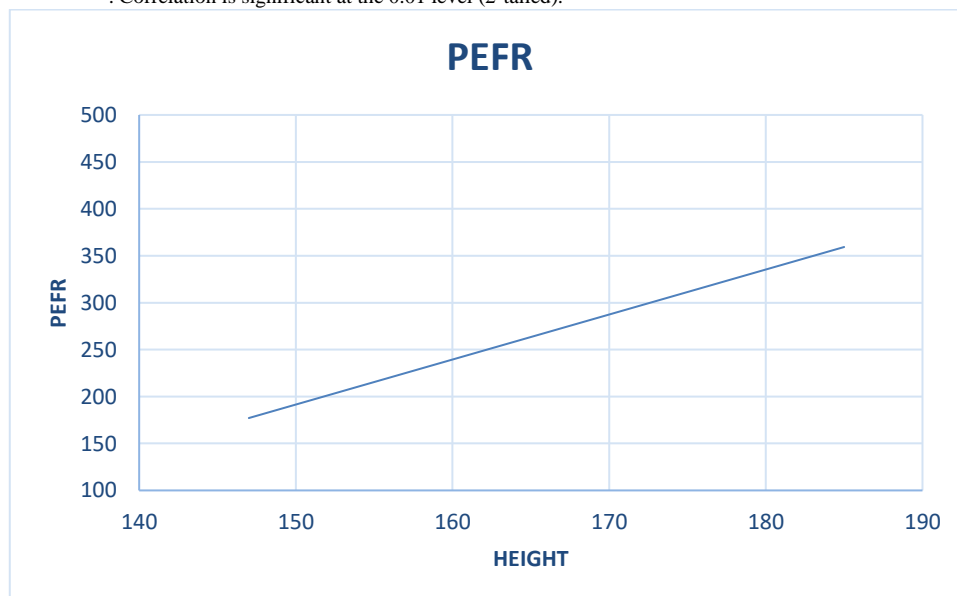


Fig. 3. Scatter plot showing correlation between Height and PEFR.

Fig. 3 shows scatter plot between height and PEFR showing significant positive correlation. We have analyzed the correlation between weight, WHR, WC, and BMI and PEFR across different BMI categories. The study population was classified into different BMI groups according to the South East Asian BMI classification. We got significant positive correlation between PEFR and BMI in normal weight, and PEFR and weight in overweight.

4. Discussion

Obesity has a direct effect on lung function. Few studies have examined variations in PEFR with WHR, especially in the South Indian population, and the relationship between PEFR and anthropometric parameters remains contentious. We aim to examine the variation in PEFR among medical students by gender and anthropometric parameters, and the effect of central obesity on respiratory efficiency using WHR and PEFR. We also try to identify variations in PEFR values among the underweight, normal weight, overweight, and obese student populations. The increasing prevalence of obesity can lead to decreased respiratory reserve. PEFR is a good indicator of respiratory function and bronchial hyperresponsiveness. The present study was conducted to determine the effects of height, weight, BMI, and WHR on PEFR among 102 medical students. The mean age of the participants was 20 ± 1.081 . 35.29% were males and 64.71% were females. Our study shows that as height increases, PEFR also increases. Similar results were found in a study conducted by Chakraborty et al. and Babu et al. in the same age group. This shows that individuals with greater height and muscular power have higher EFR values than those with lesser height.^[11, 17] Increase in height and muscular power is associated with greater strength of the respiratory muscles. In our study population, males are taller than females; this may increase PEFR values in males. But we didn't test for significance in our study, so there is a limitation to the explanation. An increase in weight due to fat deposition can decrease PEFR values.^[10] In our study, the statistical analysis showed decreased values of PEFR with an increase in weight. Similar results were shown in a study conducted by Chinnaiyan et al.^[18] Increased deposition of fat increases the mechanical work of respiratory muscles to overcome increased chest wall resistance.^[19] In our study, there was a negative, statistically significant correlation between BMI and PEFR, similar to a study by Namita et al.^[16] This suggests that obesity can be an important risk factor for impaired lung function. It causes activation of non- eosinophilic inflammatory pathways. It upregulates inflammatory cytokines, such as leptin, and downregulates anti-inflammatory cytokines, such as adiponectin.^[20] Obesity causes an increased incidence of atopic asthma as well as hyperresponsiveness of the airway. Several other studies also showed similar results.^[21, 21, 22] Waist circumference, hip circumference, and WHR are used as markers of abdominal obesity, which can lead to cardiovascular and respiratory comorbidities. Increase in waist circumference due to abdominal fat deposition can affect the descend of diaphragm thereby impairing respiratory reserve. Positive correlations between waist circumference and PEFR and between PEFR and WHR were found in a study by Rai et al., but were not statistically significant.^[22] In our study, we got a negative correlation between waist circumference and PEFR, which was statistically significant. Even though there is no statistical significance, males in our study population have a larger waist circumference than females. This can be due to the peculiar android-type fat distribution in males. However, in females, fat is more widely distributed around the hips. The negative correlation between PEFR and WHR was not significant. A study by Saxena et al. showed that WHR was the most important obesity parameter and was significantly negatively associated with PEFR.^[10] Colin et al found that an increase in WHR

is associated with lower PEFR in male subjects.^[23] In our study, we found that respiratory function is affected by height, weight, BMI, and WHR. Among those heights, the strongest predictor of lung function is. These results are consistent with previous studies. This study helps us assess whether students' respiratory efficiency is affected by body weight, height, BMI, and waist-to-hip ratio, as these factors may impair academic performance and general well-being. Further studies are required to determine the effect of obesity on students' academic performance.

Limitation of the study

The study was conducted among 102 medical students. The findings cannot be generalized because the sample size was small, and the participants were primarily young adults with relatively fewer comorbidities. This study did not account for variation in PEFR with respect to anthropometric parameters across BMI categories. Future research should address this by including variation in PEFR with respect to height, weight, BMI, waist circumference, and waist-to-hip ratio across different BMI categories. It should be conducted in a larger population.

5. Conclusion

From our study, we concluded that height, weight, BMI, and waist circumference affect PEFR values. BMI and waist circumference were significantly associated with lower PEFR, while WHR showed an inverse but statistically nonsignificant relationship. Excess abdominal fat can compress the mechanical expansion of the lungs. PEFR values are higher in people with increased height. Thus, each of the aforementioned anthropometric parameters has an individual effect on PEFR and should be considered when assessing lung function.

Conflict of Interest

The authors declared that there is no conflict of interest.

Acknowledgments

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

- [1] Kalra S, Kapoor N, Verma M, Shaikh S, Das S, Jacob J, et al. Defining and diagnosing obesity in India: A call for advocacy and action. *Journal of obesity*. 2023;2023(1):4178121. <https://doi.org/10.1155/2023/4178121>.
- [2] Sharma N, Sanjeevi RR, Balasubramanian K, Chahal A, Sharma A, Sidiq M. A systematic review on prevalence of overweight and obesity among school children and adolescents in Indian population. *Indian Journal of Endocrinology and Metabolism*. 2024;28(2):104-16. https://doi.org/10.4103/ijem.ijem_365_23.
- [3] Zammit C, Liddicoat H, Moonsie I, Makker H. Obesity and respiratory diseases. *International journal of general medicine*. 2010;3:335-43. <https://doi.org/10.2147/IJGM.S11926>.
- [4] Khan R, Kapoor A, Raza ST, Singh S. Peak expiratory flow rate (pefr) and body mass index (bmi) in adult female: a systematic review. *Era's Journal of Medical Research*. 2021;8(1). <https://doi.org/10.24041/ejmr2021.4>.
- [5] Venkateswara Babu R, Sivaganesh Devaraj V, Sabarigirivasan Harish VK. A study of the association of overweight and peak expiratory flow rate (PEFR) among children. *Journal of Evidence Based Medicine and*

- Healthcare. 2019;6(10):787-94. <https://doi.org/10.18410/jebmh/2019/163>.
- [6] Junior DC, Peixoto-Souza FS, Araujo PN, Barbalho-Moulin MC, Alves VC, Gomes EL, et al. Influence of body composition on lung function and respiratory muscle strength in children with obesity. *Journal of clinical medicine research*. 2015;8(2):105-110. <https://doi.org/10.14740/jocmr2382w>.
- [7] Yao TC, Tsai HJ, Chang SW, Chung RH, Hsu JY, Tsai MH, et al. Obesity disproportionately impacts lung volumes, airflow and exhaled nitric oxide in children. *PloS one*. 2017;12(4):e0174691. <https://doi.org/10.1371/journal.pone.0174691>.
- [8] Liyanage G, Jayamanne BD, Aaqiff M, Sriwardhana D. Effect of body mass index on pulmonary function in children. *Ceylon Medical Journal*. 2016;61(4).
- [9] Kumari S, Deo AK, Upadhyay MK. Association of BMI, Peak expiratory flow rate and sympathetic reactivity in youth. *Indian J Pharm Pharmacol*. 2019;6(2):33-6. <http://doi.org/10.18231/j.ijpp.2019.008>.
- [10] Saxena Y, Purwar B, Upmanyu R. Adiposity: determinant of peak expiratory flow rate in young Indian adults male. *Indian Journal of Chest Diseases and Allied Sciences*. 2011;53(1):29-33.
- [11] Chakraborty A, Deka J. Peak expiratory flow rate and its variation with respect to gender and anthropometric parameters among subjects of age group 18 to 35 years. *National Journal of Physiology, Pharmacy and Pharmacology*. 2025;14(11):2341-4. <http://dx.doi.org/10.5455/NJPPP.2024.v14.i11.2>.
- [12] World Health Organization. Waist circumference and waist-hip ratio: report of a WHO expert consultation, Geneva, 8-11 December 2008.
- [13] Joshi V, Shah S. Effect of body mass index (BMI) on peak expiratory flow rate in young adults. *IAIM*. 2016;3(5):85-8.
- [14] Heymsfield SB, Sorkin JD, Thomas DM, Yang S, Heo M, McCarthy C, et al. Weight/height²: Mathematical overview of the world's most widely used adiposity index. *Obesity Reviews*. 2025;26(1):e13842. <https://doi.org/10.1111/obr.13842>.
- [15] Misra A, Chowbey P, Makkar BM, Vikram NK, Wasir JS, Chadha D, et al. Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for Asian Indians and recommendations for physical activity, medical and surgical management. *Japi*. 2009;57(2):163-70.
- [16] Namita DP, Ranjan D. A cross-sectional study of assessing the effects of body mass index on peak expiratory flow rate in young people. *National Journal of Physiology, Pharmacy and Pharmacology*. 2019;9(9):828-33. 10.5455/njpp.2019.9.0519903062019.
- [17] Babu KR, Mohit M, Kolekar D. A comparative study of peak expiratory flow rate (PEFR) and BMI in male and female medical students. *Int J Health Sci Res*. 2015;5(8):273-8.
- [18] Chinnaiyan S, Ramayyan V. Comparison of Peak Expiratory Flow Rates (PEFR) between obese and non-obese Females. *Journal of Pre-Clinical and Clinical Research*. 2021;15(3):111-15. <http://dx.doi.org/10.26444/jpcr/139199>.
- [19] di Palmo E, Filice E, Cavallo A, Caffarelli C, Maltoni G, Miniaci A, et al. Childhood obesity and respiratory diseases: which link?. *Children*. 2021;8(3):177. <https://doi.org/10.3390/children8030177>.
- [20] Rubinstein I, Zamel N, Dubarry L, Hoffstein V. Airflow Limitation in Morbidly Obese, Nonsmoking Men. *Survey of Anesthesiology*. 1990;34(6):352.
- [21] Gibson G. Obesity, respiratory function and breathlessness. *Thorax*. 2000;55(Suppl 1):S41-44. https://doi.org/10.1136/thorax.55.suppl_1.s41.
- [22] Rai RH, Gupta S, Mohd A. Relationship of peak expiratory flow rate with waist circumference, hip circumference, and waist-to-hip ratio in young adults. *Annals of the National Academy of Medical Sciences (India)*. 2020;56(01):26-9. <https://doi.org/10.1055/s-0040-1712341>.
- [23] Collins LC, Hoberty PD, Walker JF, Fletcher EC, Peiris AN. The effect of body fat distribution on pulmonary function tests. *Chest*. 1995;107(5):1298-302. <https://doi.org/10.1378/chest.107.5.1298>.

How to Cite this Article: Laiju AA, Surendran DM, Joy AIE, George SI, Allenjeril NS. Association of Peak Expiratory Flow Rate with Anthropometric Parameters among Medical Students: A Cross-Sectional Study. *International Journal of Scientific Research in Dental and Medical Sciences*. 2025;7(4):149-153. <https://doi.org/10.30485/IJSRDMS.2025.550216.1682>.