

Physiology Education

# Evaluation of Peak Expiratory Flow Rate amongst Second Year Medical Students in A Nigerian University During Physiology Practical

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**Summary:** The present study evaluates the Peak Expiratory Flow Rate (PEFR) among second-year medical students during a physiology practical session at the College of Medicine and Health Sciences, Baze University, Abuja. The study involved 20 students (10 males and 10 females) aged 17-25 years. Anthropometric measurements, including standing height (in cm) and weight (in kg), were taken, and PEFR was measured in liters/minute using a Mini Wright Peak Flow Meter. An unpaired sample t-test was performed to compare anthropometric and physiological variables between genders.  $P < 0.05$  was set at the value of statistical significant. Results indicated that PEFR was significantly higher in males than females ( $P < 0.001$ ), independent of height, weight, and BMI. Additionally, a significant inverse correlation between PEFR and BMI was observed in males ( $r = -0.67$ ,  $P < 0.05$ ), whereas no significant correlation was found in females. This study underscores the gender differences in PEFR among medical students and highlights the influence of BMI on PEFR in males. These findings contribute to a better understanding of respiratory physiology in young adults and emphasize the importance of considering gender-specific factors in assessments of respiratory functions.

**Keywords:** Peak Expiratory Flow Rate, Medical students, Respiratory functions, Physiology.

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## INTRODUCTION

The peak expiratory flow rate (PEFR) is a crucial measure of respiratory function, which calculates the maximum gas flow expressed in litres per minute (L/min). It provides valuable insight into the pulmonary status of individuals' exhalation from a position of maximal inspiration (Clayton *et al.*, 2014). The British Thoracic Society also suggests it as key assessor for respiratory health for the management and diagnosis of asthma and chronic obstructive pulmonary disease (COPD) (Bansal *et al.*, 2012). In educational and clinical context, the understanding and application of PEFR offers significant benefits, particularly in the training of medical students who will end up as future healthcare providers (Good, 2003; Eleje *et al.*, 2024a).

The peak expiratory flow rate (PEFR) is a simple yet valuable technique that enhances the understanding of pulmonary function while highlighting the variability and clinical significance of respiratory measurements (Kaufman, 2018; Mann, 2011). Over the years, research has documented variations in PEFR across physiological and pathological factors, including well-established sex differences in respiratory parameters. However, regional influences, particularly in tropical climates, require further

exploration to determine if these variations align with findings from other climatic regions.

Medical education integrates physiological practical sessions to provide hands-on experience and reinforce theoretical knowledge. Among these, respiratory physiology experiments are essential, enabling students to measure and analyze their own respiratory parameters, such as PEFR (Berkhout *et al.*, 2018; Eleje *et al.*, 2024b). This experiential learning approach effectively prepares medical students for clinical practice while offering a valuable opportunity to investigate gender-related differences in respiratory function

Despite the importance, time and effort of these practical sessions, there are paucity in the documentation of data obtained from PEFR among medical students during practical classes, considering most of the reference values we use in Nigeria were obtained from US soldiers which could have differ from that of tropical climes like ours. As study conducted by Hakim *et al.*, (2023), shows that the documentation of scientific evidence aids the integration of medical science and clinical practises. Hence, this study will be valuable for several reasons. It may serve to establish the normal range of PEFR values in a specific demography, and aids in the calibration of instructional tools and set-points

for medical education and geographical variance. As well as serve as a baseline for comparative studies involving different interventions or approaches aimed towards improving the respiratory health of a given society.

This study evaluates the peak expiratory flow rate among second year medical students during physiological practical sessions by exploring the potential correlations between PEFR and variables such as gender and body mass index (BMI).

## MATERIALS AND METHODS

This cross-sectional study involved second-year medical students at Baze University's College of Medicine and Health Sciences during their physiology practical session. Participation was voluntary, as is customary for reinforcing theoretical knowledge after a 30-minute pre-lab demonstration. The study followed the Department of Human Physiology's Laboratory Manual (Exp. 25, Pp. 90) and adhered to ethical guidelines for human subject research, as approved by the Department. Out of 30 students, 10 were excluded based on health and age, leaving a sample of 20. Due to the limited population, Cochran's formula was inapplicable, and the Krejcie & Morgan table was used, incorporating the entire eligible population. The final sample consisted of 10 males and 10 females, aged 17 to 25 years.

**Experimental Protocol:** On the experimental day, a 30-minute pre-lab talk and demonstration were conducted to educate students on the significance of the experiment. The inclusion criteria required participants to be second-year medical students at Baze University, Abuja, aged between 17 and 25 years at the time of the experiment. Students with diagnosed respiratory or cardiovascular diseases were excluded.

Informed consent was obtained from each participant before they were seated in a relaxed condition. The standing height (cm) of each participant, measured without shoes, and their weight (kg) were recorded using a stadiometer. The peak expiratory flow rate (PEFR) was measured in liters per minute using a Mini Wright Peak Flow Meter.

The procedure was as follows: participants were seated, and a nose clip was applied to prevent nasal airflow. The mouthpiece of the peak flow meter was placed in the participant's mouth, held firmly between the teeth, and sealed with the lips. After a maximal inspiratory effort, participants exhaled with maximum force. The PEFR was measured three times, and the highest value was recorded as the accepted value, following the guidelines of the American Thoracic Society (ATS) (Babu *et al.*, 2015).

**Statistical Analysis:** Descriptive analyses were expressed in terms of mean±standard deviations (SDs). Normality of data distributions was analyzed using the Shapiro-Wilk test and boxplot. Unpaired sample t-test was used to test for significant difference at  $P < 0.05$ .

## RESULTS

The Peak expiratory flow rate was significantly higher in males than in females ( $P$ -value  $< 0.001$ ). The statistically insignificant difference ( $P > 0.05$ ) in anthropometric variables indicates that peak expiratory flow rate is significantly higher than the differences in both males and females is independent of height, weight and BMI (Table 1). There was a strong linear correlation between weight and BMI. Intriguingly, peak expiratory flow rate showed statistically significant inverse association with BMI with a correlation coefficient of  $-0.67$  ( $P < 0.05$ ) in males but no statistically significant association with females (Table 2).

## DISCUSSION

In this study, we explored the anthropometric and physiological differences between males and females, with a specific focus on the Peak Expiratory Flow Rate (PEFR). The PEFR significantly increases in males compared to females which is in agreement with existing physiology literatures indicating that males generally have higher lung volumes and respiratory capacities than females, which can be attributed to anatomical and physiological differences such as larger airway diameters and greater lung volumes in males (Mishra *et al.*, 2013, Babu *et al.*, 2015, Jena *et al.*, 2017). However, there were no significant differences in anthropometric variables such as height, weight, and BMI between the sexes. This finding contradicts some literature that has reported sex-based differences (Sanchez *et al.*, 2018). The results of this study may be due to a relatively small sample size or similar physical characteristics among the participants (Aliasghari *et al.*, 2020).

Previous research has shown that while there are average differences in height and weight between males and females, these differences can vary significantly based on the population and specific sample characteristics (Danborno *et al.*, 2021; Cattellino *et al.*, 2025). As expected, weight and BMI showed a strong positive linear correlation in both males and females as BMI is a direct function of weight and height. One intriguing finding is the significant inverse association between PEFR and BMI in males; this suggests that higher BMI is associated with lower PEFR in males, which aligns with studies indicating that increased adiposity can negatively impact pulmonary function due to factors like reduced chest wall compliance and respiratory muscle inefficiency (Severin, 2022).

**Table 1:**  
Selected Anthropometric variable and peak expiratory flow rate

Variables	Male	Female	t-value	P-value
	Mean ± SD	Mean ± SD		
Height (cm)	178.80 ± 5.90	174.20 ± 4.26	2.00	0.061
Weight (kg)	92.20 ± 14.85	80.90 ± 16.53	1.61	0.125
BMI (kg/m <sup>2</sup> )	28.85 ± 4.37	26.66 ± 5.38	1.00	0.329
PEFR (L/min)	556.30 ± 89.59	402.40 ± 71.86	4.24	<0.001

**Table 2:**  
Correlation matrix of the key variables

Variables	1	2	3	4
1. Height	1	0.29	-0.12	0.34
2. Weight	0.24	1	0.92**	-0.53
3. BMI	-0.01	0.97**	1	-0.67*
4. PEFR	0.57	0.58	0.45	1

Above the diagonal, males; below the diagonal, females

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

\* : Correlation is significant at the 0.05 level (2-tailed)

Interestingly, this association was not observed in females, which might be due to differences in fat distribution patterns, hormonal influences, or other sex-specific physiological factors (Cyril *et al.*, 2024). These findings have important implications for understanding sex differences in respiratory health and the impact of body composition on lung function (Babu *et al.*, 2015, Jena *et al.*, 2017). The significant inverse correlation between PEFR and BMI in males highlights the potential respiratory risks associated with higher BMI, emphasizing the need for targeted interventions to address obesity and its impact on respiratory health in men.

Future research should aim to explore the underlying mechanisms driving the sex-specific differences observed in this study. Larger, more diverse samples could provide a clearer picture of these relationships and help determine whether these findings are generalizable across different populations. Additionally, longitudinal studies could investigate how changes in BMI over time affect PEFR and whether similar patterns are observed in females with larger sample sizes.

In conclusion, this study further highlights the importance of considering sex differences in respiratory health research. The significant difference in PEFR between males and females, independent of anthropometric variables, along with the inverse relationship between PEFR and BMI in males observed in this study, highlights the complex interplay between sex, body composition, and pulmonary function. These findings contribute to the broader understanding of respiratory physiology and can inform clinical practices and public health strategies aimed at improving respiratory health outcomes.

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