ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 11 | November - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

NAVIGATING THE HEIGHT - PEAK EXPIRATORY FLOW RATE DYNAMIC: GENDER DIFFERENCES IN RESPIRATORY FUNCTION AMONG YOUNG ADULTS

Physiology

Dr Trishla Sood* Senior Resident, Department of Physiology, Atal Bihari Vajpayee Institute of Medical Sciences and Dr. Ram Manohar Lohia Hospital, New Delhi *Corresponding Author

Dr Jyoti Yadav Senior Professor and Head, Department of Physiology, Pt. BD Sharma PGIMS, Rohtak

ABSTRACT

Background: Limited studies have explored the correlation between height and Peak Expiratory Flow Rate (PEFR) in young Indian adults aged 18-24 years. **Objective:** This study aimed to investigate the relationship between height and PEFR in young healthy adults, including both males and females. **Method:** In this cross-sectional study, sixty healthy individuals were assessed. Height was measured with a stadiometer, and PEFR was measured using a Wright's peak flow meter. Strict criteria excluded participants with conditions affecting PEFR. **Results:** A significant positive correlation between mean height and PEFR was found ($r = 0.664$, $p < 0.001$). Gender differences emerged: a weak correlation for females ($r = 0.164$, $p = 0.388$) suggested height is not a reliable predictor of respiratory function, while males showed a moderate correlation ($r = 0.422$, $p = 0.02$). **Conclusion:** This study emphasizes the need for gender-specific considerations in respiratory evaluations and suggests future research explore other factors influencing PEFR, expanding sample sizes for broader applicability.

KEYWORDS

Stadiometer, PEFR, Wright's Peak flow meter.

INTRODUCTION

Wright and McKerrow (1959) evaluated the maximum forced expiratory flow rate as an indicator of ventilatory capacity and reviewed its historical context. They introduced the peak flow meter, detailing its calibration method, and found that its readings were significantly higher than those obtained through previous techniques. Their study suggests that the peak flow rates measured with this device may provide a convenient and reliable estimate of ventilatory capacity.[1] Peak flow meters are often utilized to track asthma. A European Respiratory Society working group focused on peak expiratory flow (PEF), emphasizing its importance over peak expiratory flow rate (PEFR). PEF is influenced by lung volume, which varies with chest size. Males generally have higher PEF due to greater alveolar pressure, but until about 13-15 years, boys and girls of the same height produce similar PEF due to narrower airways. Additionally, expiratory muscle strength and PEF gradually decline with age.[2]

Understanding PEFR is vital for assessing respiratory health, especially in young adults, as it reflects pulmonary function and overall fitness. This research aims to explore PEFR norms, focusing on gender differences due to physiological variations. Our goal is to provide data that can improve clinical assessments, enhance public health strategies, and inform tailored interventions for respiratory health in young adults.

MATERIALS AND METHODS

The present study was conducted in the department of Physiology, Pt. B.D. Sharma, PGIMS, Rohtak. Sixty volunteering young healthy adults, 30 females and 30 males, between the age group of 18-24 years were included in the study. Individuals having common cold, nasal polyps, deviated nasal septum, chronic sinusitis, allergic sinusitis, atrophic rhinitis, chronic smokers and patients with recent nasal infection, cardiovascular and respiratory system diseases, history of chest wall injuries and kyphoscoliosis were excluded from the study. The study protocol was approved by Institutional Ethical Committee.

A written consent for both peak expiratory flow rate was taken after explaining the method of study. Strict criteria of "normality" was applied and included history of medical illnesses, general examination and systemic examination. For peak expiratory flow rate, Wright's peak flowmeter was required.

The PEFR was measured by using Wright's peak flow meter by connecting the subject with the help of mouthpiece. The Wright's peak flow meter depends on the rotation of a vane attached to a spiral spring. Movement of the vane uncovers an annular orifice and a point at which pressure behind the vane balances the force of the spring, depends on the flow rate. The recording scale in the standard Wright's peak flow meter ranges from 50 to 1000 L/min, and it weighs about 900 gms. The technique of peak expiratory flow rate was explained and demonstrated to the subject. The subjects performed the test during day time, in standing position holding the peak flowmeter properly. He/she was asked to take a deep breath and then exhale it by forceful expiration as fast as possible after maintaining the tight seal between lips and mouthpiece of the instrument. Maximum of the three readings of peak expiratory flow rate was considered and result was expressed in litres per minute.

Statistical Analysis

PEFR measurements were collected from the subjects and subsequently analyzed using SPSS software version 20 for statistical evaluation. Level of significance was $p < 0.05$.

RESULTS

Height and PEFR were correlated using Pearson's Equation. This was done in 30 females and 30 males (Table 1, Figure 1, Figure 2) and in a total of sixty subjects (Table 2, Figure 3).

Mean Height (cms) and Mean PEFR (L/min) value of young healthy females (n=30) of age group 18-24 years are 159.94 ± 5.29343119 and 429.80 ± 39.368, respectively. However, Mean Height (cms) and Mean PEFR (L/min) value of young healthy males (n=30) of age group 18-24 years are 174.686667 ± 7.7164729 and 524.03 ± 68.233, respectively. (Table 1).

Table 1: Mean Height (cms) and Mean PEFR (L/min) Value of Young Healthy Females (n=30) and Males (n=30) of Age Group 18-24 Years.

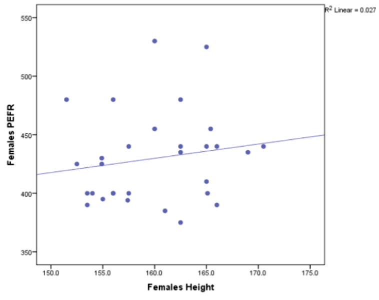
Parameter	Gender	N	Mean ± SD	Range
Height	Females	30	159.94 ± 5.29343119	151.5 – 170.5
	Males	30	174.686667 ± 7.7164729	160 - 188
PEFR (L/min)	Females	30	429.80 ± 39.368	375 - 530
	Males	30	524.03 ± 68.233	430 - 675

Mean Height (cms) and Mean PEFR (L/min) value of young healthy adults including both females and males (n=60) of age group 18-24 years are 167.313333 ± 9.91602823 and 476.916667 ± 72.8546944, respectively. (Table 2)

Table 2: Mean Height (cms) and Mean PEFR (L/min) Value of Young Healthy Adults Including Both Females and Males of Age Ggroup 18-24 years (n=60).

Parameter	Gender	N	Mean ± SD	Range
Height	Both females and males	60	167.313333 ± 9.91602823	151.5 - 188
PEFR (L/min)	Both females and males	60	476.916667 ± 72.8546944	375 - 675

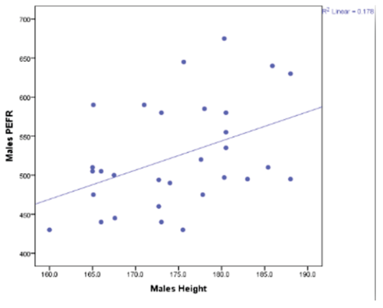
When the mean values of Height & PEFR of young healthy 30 females were correlated, it revealed a weak positive correlation ($r = 0.164$), which was insignificant (p 0.388). (Figure 1)



r = Pearson's r, p < 0.05 = significant.

Figure 1: Correlation between Height (cms) and PEFR (L/min) in young healthy females of age group 18-24 years.

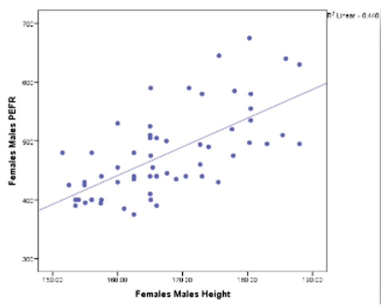
When the mean values of Height & PEFR of young healthy 30 males were correlated, it revealed a good positive correlation (r = 0.422), which was significant (p 0.02). (Figure 2)



r = Pearson's r, p < 0.05 = significant.

Figure 2: Correlation between Height (cms) and PEFR (L/min) in young healthy males of age group 18-24 years.

However, the correlation between height and PEFR of young healthy adults (n=60) including both females and males, revealed a very good positive correlation (r = 0.664), which was significant (p < 0.001). (Figure 3)



r = Pearson's r, p < 0.05 = significant.

Figure 3: Correlation between Height (cms) and PEFR (L/min) in young healthy adults, including both females and males of age group 18-24 years.

DISCUSSION

Kumaran and Agrawal (2017) conducted a study in Jabalpur, Madhya Pradesh, assessing Peak Expiratory Flow Rate (PEFR) in 2,156 healthy school children aged 10 to 16. Using a mini Wright peak flow meter, they found significant correlations between PEFR and height (r = 0.847), weight (r = 0.750), and BMI (r = 0.466, p < 0.001). They developed gender-specific nomograms and prediction equations, demonstrating that PEFR is influenced by anthropometric factors.[3] In a related study, Namita and Ranjan DP (2019) explored the impact of BMI on PEFR in young individuals from Raichur district. They reported average PEFR values of 500 lpm for males and 350 lpm for females, with peak values occurring between ages 18 and 20. Their findings also highlighted a positive correlation between height and PEFR, with males exhibiting significantly higher PEFR than females.[4] Together, these studies emphasize the relevance of anthropometric measurements in evaluating PEFR and the utility of PEFR as a portable indicator of respiratory health in youth.

Jena et al. (2017) investigated the relationship between peak expiratory flow rate (PEFR) and body mass index (BMI) in 105 young adults (56 males and 49 females). Participants were categorized into normal, overweight, and obese based on BMI. Measurements taken between 7 and 8 AM indicated that males had PEFR values of 498 L/min (normal), 488 L/min (overweight), and 391 L/min (obese); females recorded values of 377 L/min, 348 L/min, and 325 L/min, respectively. The study revealed a negative correlation between BMI and PEFR, showing that PEFR declines with increasing BMI.[5] In a separate study by Atta, Zia, and Jabeen (2019) at the University Medical and Dental College, Faisalabad, 210 participants aged 18 to 25 were examined. They found that PEFR was positively influenced by height, with taller individuals demonstrating higher PEFR values.[6] Additionally, Thomas et al. (2021) conducted a cross-sectional observational study involving 1,276 volunteers. This study established significant correlations between PEFR and factors such as age, gender, and height, highlighting a linear relationship between height and PEFR in both males and females.[7] Overall, these studies collectively emphasize the influence of BMI and height on PEFR in young adults.

Ray et al. (1993) conducted a pioneering study on peak expiratory flow (PEF) among 200 rural residents in Tamil Nadu, India, revealing significant variations in lung function influenced by climate and diet. Their findings showed PEF values ranging from 150 to 680 l/min for males and 150 to 500 l/min for females, peaking at ages 32.5 and 35.6, respectively. The study identified significant correlations between PEF and both height and age, providing regression equations for normal PEF values in this population.[8] Similarly, Gupta and Rai (2019) found a positive but statistically non-significant relationship between peak expiratory flow rate (PEFR) and height in a study of 61 subjects from South Delhi.[9] Chandel et al. (2022) observed a positive correlation between PEFR and height in healthy adult males aged 18-45 years in Patiala.[10] Additionally, Sandhu et al. (2022) assessed PEFR in 117 female subjects over 65 in Amritsar, concluding that taller individuals tend to have higher PEFR.[11] These studies collectively underscore the importance of height as a factor influencing PEF across various Indian populations.

Seema et al. (2014) assessed peak expiratory flow rate (PEFR) using a mini Wright peak flow meter in 150 healthy individuals of similar socioeconomic status, finding a significant positive correlation ($p < 0.05$) between PEFR and height in younger adults.[12] Similarly, Mishra et al. (2013) studied 181 healthy young adults to analyze factors influencing PEFR, particularly height and weight. Utilizing "The Peak" individualized flow meter, they observed a positive correlation between PEFR and both height and weight, with a stronger relationship for height in males and weight in females.[13] Additionally, Kodgule et al. (2014) established reference values for peak expiratory flow (PEF) in Indian adults using a European Union scale peak flow meter, analyzing data from 6,138 participants. Their findings highlighted gender, age, and height as significant determinants of PEF, showing that taller individuals tend to have higher values. Importantly, Indian adults' PEF values were approximately 30% lower than those of Europeans, emphasizing the need for localized reference values.[14]

Taksande et al. (2008) studied normal peak expiratory flow rate (PEFR) in 1,078 healthy rural school children from Wardha, Maharashtra, using a Mini-Wright peak flow meter. They found a positive correlation between PEFR and age, height, and weight, with boys having higher values than girls. Prediction equations were developed: PEFR = 3.64 × height (cm) - 257.86 for girls and PEFR = 4.7 × height (cm) - 346.51 for boys. The study concluded that PEFR is a reliable measure for assessing airway obstruction, offering tailored prediction formulas for the local population.[15]

Pelizzo et al. (2024) and Venkatachalem and Prakash (2016) highlight the crucial roles of hormones and sex differences in lung health, particularly in pediatric populations. Pelizzo et al. emphasize how hormones like glucocorticoids, thyroid hormones, and insulin influence lung development and function, affecting ventilation, perfusion, and inflammation. They call for further research to clarify these hormones' specific roles, which could lead to personalized therapeutic strategies for pediatric respiratory issues.[16] Venkatachalem and Prakash (2016) examined sex differences in pulmonary anatomy and the impact of sex steroids (estrogen, progesterone, testosterone) on lung health. They noted that while the roles of these hormones in other health domains are well-established, their specific effects on respiratory conditions such as asthma and COPD remain unclear. This study explored how sex steroid signaling may differentially influence airway structure and function throughout life.[17] Additionally, Maiolo et al. (2003) investigate the relationship between body composition and respiratory function, noting only slight correlations between body weight and lung function when accounting for age and height. They highlight that upper body fat negatively affects airway function, while increased muscle mass is associated with better spirometric outcomes.[18] Collectively, these studies underscore the complex interplay of hormones, sex differences, and body composition in respiratory health.

Sheel and Guenette (2008) demonstrated that women typically have smaller airways, reduced lung volumes, and lower maximum expiratory flow rates than men, with female athletes experiencing greater expiratory flow limitations and increased lung volume during high-intensity exercise. This results in a higher metabolic cost of breathing, illustrating notable sex differences in respiratory mechanics.[19] Similarly, Chen and Kuo (1989) studied 160 healthy participants to investigate the effects of gender and age on respiratory muscle function. Their findings indicated that men generally exhibited superior respiratory strength and spirometric measures, with declines in function linked to aging. Additionally, smoking adversely affected respiratory metrics, while physically active men showed enhanced inspiratory endurance compared to sedentary individuals.[20] Together, these studies highlight the complex interactions of gender, age, smoking, and physical activity on respiratory function.

CONCLUSION

In conclusion, this research underscores the complex relationship between height and PEFR in young adults, revealing significant gender-based differences. For females, the weak correlation ($r = 0.164$) and lack of statistical significance ($p = 0.388$) suggest that height is not a reliable predictor of respiratory function, indicating that other factors may play a more crucial role. Conversely, the moderate positive correlation observed in males ($r = 0.422$, $p = 0.02$) aligns with expectations regarding lung capacity and height, demonstrating that taller males generally exhibit better PEFR.

When considering both genders collectively, the strong correlation ($r = 0.664$, $p < 0.001$) highlights the value of integrating gender-specific analyses to gain a comprehensive understanding of respiratory health. The differing correlations between males and females may reflect biological and physiological distinctions, such as genetic influences, hormonal variations, and differences in lung structure and respiratory muscle strength.

These insights emphasize the necessity for healthcare providers to consider gender-specific factors in respiratory evaluations and interventions, recognizing that height alone may not uniformly predict lung function across populations. Future research should investigate additional variables influencing PEFR, including physical fitness and environmental factors, while expanding sample sizes to enhance the applicability of findings.

Ultimately, this study contributes valuable knowledge to the field of respiratory health, emphasizing the importance of gender considerations in assessing lung function and the multifaceted nature of respiratory predictors in young adults.

REFERENCES

1. Wright, B. M., & McKerrow, C. B. (1959). Maximum forced expiratory flow rate as a measure of ventilatory capacity: With a description of a new portable instrument for measuring it. British Medical Journal, 2(5159), 1041–1046. https://doi.org/10.1136/bmj.2.5159.1041
2. Quanjer, P. H., Lebowitz, M. D., Gregg, I., Miller, M. R., & Pedersen, O. F. (1997). Peak expiratory flow: Conclusions and recommendations of a Working Party of the European Respiratory Society. The European Respiratory Journal, Supplement, 24, 2S–8S.
3. Kumaran, K., & Agrawal, A. (2017). Normal peak expiratory flow rate of school children in Jabalpur, Madhya Pradesh. Indian Journal of Pediatrics, 84(8), 580–584. https://doi.org/10.1007/s12098-017-2344-y
4. Namita, R., & Ranjan, D. P. (2019). 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, 9(9), 828–833.
5. Jena, S., Mirdha, M., Meher, P., & Misra, A. K. (2017). Relation of peak expiratory flow rate to body mass index in young adults. Muller Journal of Medical Sciences and Research, 8, 19. https://doi.org/10.4103/0975-9727.199369
6. Atta, K., Zia, S., & Jabeen, F. (2019). Impact of anthropometric parameters on peak expiratory flow rate: Anthropometric parameters & PEFR. Journal of Aziz Fatimah Medical & Dental College, 1(2), 63–66. https://doi.org/10.55279/jafmdc.v1i2.55
7. Thomas, J. A., Babu, S., David, S. S., Prasad, K. P. G., James, A., George, A. J., & Augustine, J. (2021). Peak expiratory flow profile among healthy adult individuals in Central Kerala: A cross-sectional observational study. Journal of Research in Medical and Dental Sciences, 9(11), 156–161.
8. Ray, D., Rajaratnam, A., & Richard, J. (1993). Peak expiratory flow in rural residents of Tamil Nadu, India. Thorax, 48(2), 163–166. https://doi.org/10.1136/thx.48.2.163
9. Gupta, S., & Rai, R. (2019). To determine the correlation of BMI, height, and weight with peak expiratory flow rate in young adults. International Journal of Scientific Research and Review, 8, 163–169.
10. Chandel, R., Shivhare, G., & Bhagat, A. (2022). Anthropometric variables and PEFR. Central European Journal of Sport Sciences and Medicine, 39, 75–80.
11. Sandhu, P. K., Ghay, R., Singh, J. P., & Arora, M. (2022). Peak expiratory flow rate: Anthropometric factors affecting it in elderly females and reference values. AMEI's Current Trends in Diagnosis & Treatment, 6(2), 23–26.
12. Seema, S., Verma, K. B., Goel, S. K., Ghosh, S., & Bera, C. (2014). Correlation of peak expiratory flow rate with anthropometric determinants in healthy adult male population of Haryana. Journal of Evolution of Medical and Dental Sciences, 3(30), 8355–8365.
13. Mishra, J., Mishra, S., Satpathy, S., Manjareeka, M., Nayak, P., & Mohanty, P. (2013). Variations in PEFR among males and females with respect to anthropometric parameters. IOSR Journal of Dental and Medical Sciences, 5, 47–50.
14. Kodgule, R. R., Singh, V., Dhar, R., Saicharan, B. G., Madas, S. J., Gogtay, J. A., Salvi, S. S., & Koul, P. A. (2014). Reference values for peak expiratory flow in Indian adult population using a European Union scale peak flow meter. Journal of Postgraduate Medicine, 60(2), 123–129. https://doi.org/10.4103/0022-3859.132311
15. Taksande, A., Jain, M., Vilhekar, K., & Chaturvedi, P. (2008). Peak expiratory flow rate of rural school children from Wardha district, Maharashtra, India. World Journal of Pediatrics, 4(3), 211–214. https://doi.org/10.1007/s12519-008-0039-1
16. Pelizzo, G., Calcaterra, V., Baldassarre, P., Marinaro, M., Taranto, S., Ceresola, M., Capelo, G., & Zuccotti, G. (2024). The impact of hormones on lung development and function: An overlooked aspect to consider from early childhood. Frontiers in Endocrinology, 15, Article 1425149. https://doi.org/10.3389/fendo.2024.1425149
17. Venkatachalem, S., & Prakash, Y. S. (2016). Sex differences in pulmonary anatomy and physiology: Implications for health and disease. In G. N. Neigh & M. M. Mitzelfelt (Eds.), Sex differences in physiology (pp. 89–103). Academic Press. https://doi.org/10.1016/B978-0-12-802388-4.00006-9
18. Maiolo, C., Mohamed, E. I., & Carbonelli, M. G. (2003). Body composition and respiratory function. Acta Diabetologica, 40(Suppl 1), s32–s38. https://doi.org/10.1007/s00592-003-0023-0
19. Sheel, A. W., & Guenette, J. A. (2008). Mechanics of breathing during exercise in men and women: Sex versus body size differences? Exercise and Sport Sciences Reviews, 36(3), 128–134. https://doi.org/10.1097/JES.0b013e31817be7f0
20. Chen, H. I., & Kuo, C. S. (1989). Relationship between respiratory muscle function and age, sex, and other factors. Journal of Applied Physiology, 66(2), 943–948.