e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.6.36

International Journal of Pharmaceutical Quality Assurance 2025; 16(6); 199-203

Original Research Article

Variations in PEFR Among Males And Females In Type-2 Diabetes Mellitus

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Received: 10-04-2025 / Revised: 23-05-2025 / Accepted: 24-06-2025
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Conflict of interest: Nil

Abstract:

This study aimed to evaluate the effect of gender on pulmonary functions forced vital capacity [FVC], forced expiratory volume in 1st s [FEV1] and peak expiratory flow rate [PEFR]) and to emphasise the need for further research on the aetiology and the prevention of respiratory diseases, This cross-sectional study was conducted in the Department of Physiology, D.Y Patil medical college Kolhapur , India, from May 2011 to May 2013. A total of 100 participants, were included via random sampling method. The participants filled out a questionnaire with general information about previous diseases, medication and family history. Fifty male participants were enrolled in the study group according to inclusion and exclusion criteria. 50 female participants were included. Respiratory parameters such as FVC, FEV1 and PEFR were measured by a digital spirometer. Readings were taken in normal upright sitting posture.

Results: Female participants showed significantly lower FVC, FEV1 and PEFR than males.

Keywords: Pulmonary Function Test, FVC, FEV1, Peak Expiratory Flow Rate.

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Introduction

Diabetes mellitus is a public health problem in developing and developed world, according to WHO, India will be world diabetic capital in 2025. Diabetes is a complex medical syndrome comprising of heterogeneous group of disease resulting from diverse aetiologies predominatly of genetic and environmental origin. DM affects almost all the organ systems in the body producing biochemical, morphological and functional abnormalities mainly of collagen and elastine. The alterations in these scleroproteins in turn affect the mechanical behavior of the lungs manifesting in altered lung volumes measured by pulmonary function tests. The underlying mechanism seems to be microangiopathy brought in by the non-enzymatic glycosylation of various scleroproteins in lungs and elsewhere. Since collagen is the most abundant tissue protein in major bronchi, vessels and interstitium, the alterations in pulmonary functions occur as a rule.

In the context of rising prevalence of DM, particularly in developing countries and in younger age groups and since these changes can potentially incapacitate the patients, it is of utmost importance to not only define these changes but also find ways of retarding the progression of disease so that they do not become irreversible. Many different lung function parameters can be studied by spirometry.[1] Spirometric lung function parameters are used as a diagnostic tool to monitor therapeutic effectiveness or disease course.[2] The most commonly studied parameters include: (i) vital capacity (VC), the maximum volume of air that can be expelled from the lungs after maximum inspiration and (ii) forced VC (FVC), the volume of air that can forcibly be blown out after full inspiration, (iii) forced expiratory volume in 1st s (FEV1), the maximum volume of air that can be forcibly blow out in the 1st s during the FVC manoeuvre[3] (iv) peak expiratory flow rate (PEFR) is defined as 'The largest expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration, expressed in liters per minute. It is well known that lung function capacity is influenced by the sex of the subject as well as other factors, including age, height and ethnicity.[4] Respiratory parameters such as FVC, FEV1 and PEFR are significantly lower in female participants than male participants.[5] The female lung is smaller than the male lung and has fewer bronchioles. The number of alveoli per unit of the surface area is the same in both boys and girls.[5] Women tend to have 20%–25% lower lung capacity than men, which is attributed to the smaller lung size of women.[6] According to the study performed by Ja-

cobs et al., many of the typical sex differences in respiratory function result from differences in body size.[7] After adolescence, the VC of boys exceeds those of girls of similar height, with most of the differences attributable to differences in proportions of the body frame.[7] The difference might be due to the subject's smaller height, affecting pulmonary function parameters.[8] Because boys have bigger lungs per unit of stature, they have a more significant number of alveoli and a larger alveolar surface area for a given age and stature.[9] The lung function values are higher in males than females because males have larger lungs and muscularity than females.[10]

These results were comparable with the study by Aggarwal et al., in which they found that the mean lung function test was higher in boys than in girls.[10] Budhiraja et al. also reported lower pulmonary function values in female than male participants in similar age groups.[11] This can be attributed to men having bigger lungs for the same height as females.[11] Another contributing factor could be the greater strength of respiratory muscles in males.[12] The sex difference in lung function may be attributed to various factors, including sex hormone, sex hormone receptors or intracellular signalling pathways, in addition to physiological and anatomical differences in the respiratory system of males and females.[13] Rajput et al. observed that FVC for males was significantly higher than for females.[14] This may be attributed to the greater respiratory muscle strength of males.[15] Males have more alveoli per unit area than their female counterparts, and their alveoli are larger and have greater compliance.[16] All the flow rates were higher in males than females.

Larger airways and stronger respiratory muscles of males are responsible for higher flow rates. According to Jeena et al., increased weight decreases lung volume and capacities by decreasing lung and chest wall compliance.[17] There is also an increase in resistance to outflow of air through the airways in the overweight.[18] The pattern of pulmonary function is found to worsen with the degree of obesity, moving from a restrictive pattern in mild to moderate obesity with both FEV1 and FVC reduced and FEV1/FVC ratio being normal to an obstructive pattern in severe and morbid obesity with a significant decrease in FEV1 as against FVC and FEV1/FVC ratio being decreased. [19,20] PEFR is positively correlated with an increase in height and weight up to a specific limit and decreases as height and weight increase.[21] Significant correlation has been previously reported for PEFR with height, weight, age, socio-economic conditions, chest circumference and body surface area.[22] The mean values of height, weight and PEFR were higher for males than females. Similar findings were reported by other researchers also.[23] In males, PEFR increases significantly with height and weight, which agrees with the reports of other investigators.[24] This was probably because of the greater chest volume in the taller subjects. The growth of the airway passages and the expiratory muscle effort also increases with an increase in height. The male's height is associated with PEFR, and female weight is correlated with PEFR.[21] The proposed mechanism for the link between obesity and deceased PFTs explained by the restrictive effect on the lung and chest wall as the accumulation of excess fat could interfere with the movement of the chest wall and descent of the diaphragm.[25] Increased adiposity has been associated with increased levels of cytokines such as interleukin 6 and tumour necrosis alpha and decreased adiponectin levels, thereby increasing systemic inflammation and negatively affecting lung function. [26,27]

Materials and Methods

Design of the study: A cross-sectional study of the lung function of diabetics compared between male and female diabetics.

Materials: RMS Helios 702 spirometer, Microsoft Excel and SPSS Version 10 software.

Methodology

Over a period of 2 years, patients with type 2 diabetes mellitus who were attending medical OPD of Dr. D. Y. Patil Medical College Hospital were included in the study. They were requested to attend a medical interview, and underwent physical examination including fundoscopy. Non-smoking diabetic patients who had no history of respiratory disease, and who gave informed consent were selected for this study, and underwent pulmonary function testing. Healthy, nonsmoking, non-diabetics who were matched for age and sex were chosen as controls, and also underwent pulmonary function testing. The results were entered on a Microsoft Excel spreadsheet and were analyzed using SPSS version10.0software.

Inclusion criteria: Type 2 Diabetes mellitus of at least 6 months duration, able to give informed consent. Diabetics who have never smoked, with no past history of lower respiratory illness and who did not show at the time of the examination, symptoms related to respiratory illness. These included nasal itching, nasal congestion, running nose, dry throat, hoarseness, epistaxis, sneezing, pain suggestive of sinusitis, cough, expectoration and dyspnea.

Exclusion criteria:

- Smokers
- Present or past history of respiratory diseases that might affect lung function such as asthma, COPD, tuberculosis, bronchiectasis, interstitial lung disease.
- History of occupational exposure to any substances that could affect lung function.
- Individuals with current or recent upper respiratory or lower respiratory infection, that could pre-dispose to heightened airway reactivity.
- Individuals with unacceptable spirometric technique. An unacceptable spirometry was that in which FEV1 or FVC could not be correctly measured due to

  o Cough,
  o Obstruction of teeth or tongue
  o Sub-maximal effort
  o Air escape
  o Effort sustained for less than 6 seconds duration
  o Failure to attain a plateau on volume time curve
  o Lack of understanding of the procedures
  o Recent surgery.

RMS Helios spirometer calibrated daily, was used for all pulmonary function measurements according to ATS performance criteria.

The subjects' details including age, sex, and height of the subject were recorded on the patient data sheet of Spirotrac was software. The test procedure explained to the subjects. The object of the test was to obtain reproducible records of the flow volume loop and a volume time curve. All efforts were made to secure three satisfactory and reproducible expiratory maneuvers, and the best results ("ATS best") recorded in an ATP (ambient, temperature and pressure, saturated) scale. The final spirometry reports were saved and analyzed using Microsoft Excel worksheet and SPSS software.

Observation and Results

A total number of 100 cases were suitable for analysis. There were 50 male diabetics and 50 female diabetics.

Table no 1 shows the significant difference in FVC, FEV1 and PEFR in the female group.

Table 1: Comparison of PFT parameters among Male and Female

	Male DM	Female DM		
FVC	3.23 ± 0.80	2.65 ± 0.44	t=3.36	P=0.0021**
FVC Observed	7.18 ± 3.83	7.96 ± 9.19	t=0.40	P=0.78
FVC Pred %	269.44 ± 183.76	258.06 ± 128.45	0.27	P=0.78
FEV 1 Observed	41.59 ± 2.23	3.51 ± 1.70	0.27	P=0.78
FEV 1 Pred %	193.24 ± 83.55	154.76 ± 64.75	1.92	0.0619
FEV 1/FVC Pred	76.77 ± 13.69	64.33 ± 14.89	1.925	0.0619
FEV1/FVC Observed	60.20 ± 12.65	51.29 ± 11.87	2.92	0.0054**
FEV 1/FVC Pred %	79.13 ± 10.92	82.75 ± 12.04	2.92	0.0054**
PEFR Pred	6.83 ± 0.60	5.47 ± 1.09	t=6.85	P<0.0001
PEFR Observed	6.69 ± 2.36	5.69 ± 2.064	t=1.789	P=0.080
PEFR Pred %	55.08 ± 50.36	120.38 ± 122.78	t=1.789	P=0.08
	55.06 ± 45.18	81.31 ± 15.86	t=1.789	P=0.080

When spirometric values of male DM and female DM were considered. The differences were statistically significant only among females. The test used for statistical analysis is unpaired T test welch corrected.

Discussion

This study was undertaken to assess the ventilatory function in patients with type II diabetes mellitus and compare it with those of non-diabetic healthy subjects of same age groups; to correlate changes in PFT in between male & female subjects.

For all parameters FVC, FEV1, FEV1/FVC, PEFR males had higher mean values than females among diabetes. The lesser height of females than males might have contributed to the decrease, as respiratory functions are affected by height of the individuals. [28]. FEV1 fall in values was more pronounced among females than among diabetic males. PEFR positively correlates with increased height and weight upto a certain limit.[21] The association of PEFR with height and weight in both genders, males and females, increases to a certain level of increasing height and weight and then decreases as the height and weight increase further.[21] Significant correlation has been previously reported for PEFR with height, weight, age, socio-economic conditions, chest circumference and body surface area.[22] This study also showed that in males, PEFR increases significantly with height and weight, which agrees with the reports of other investigators.[29] This was probably because of the greater chest volume in the taller subjects.[29] The growth of the airway passages and the expiratory muscle effort also increases with an increase in height.[29] Jena concluded that PEFR declines with increased BMI, and there is a negative correlation between BMI and PEFR.[29,]

Conclusion

The present study showed that males had higher FVC, FEV1 and PEFR than females. Positive correlation between FVC, FEV1 and PEFR and height, weight and BMI among both genders.

Acknowledgement: I am thankful to our laboratory staff and colleagues in the department of physiology for helping us in conducting this study.

References

1. Alghadir A, Aly F, Zafar H. Sex-based differences in lung functions ofSaudi adults. J Phys Ther Sci 2012;24:5-9.
2. Ostrowski S, Barud W. Factors influencing lung function: Are the predicted values for spirometry reliable enough? J Physiol Pharmacol 2006;57 Suppl 4:263-71.
3. Pierce R. Spirometry: An essential clinical measurement. Aust Fam Physician 2005;34:535-9.
4. Blair ML. Sex-based differences in physiology: What should we teach in the medical curriculum? Adv Physiol Educ 2007;31:23-5.
5. Aggarwal T, Singh D, Sharma B, Siddique SS, Agarwal S. Correlation of gender and body mass index with pulmonary function tests in medical and paramedical students of muzaffarnagar medical college. National J Physiol Pharm Pharmacol 2017;7:1155-8.
6. Ho WC, Lin YS, Caffrey JL, Lin MH, Hsu HT, Myers L, et al. Higher body mass index may induce asthma among adolescents with pre-asthmatic symptoms: A prospective cohort study. BMC Public Health 2011;11:542.
7. Jacobs DR Jr., Nelson ET, Dontas AS, Keller J, Slattery ML, Higgins M. Are race and sex differences in lung function explained by frame size? The CARDIA Study. Am Rev Respir Dis 1992;146:644-9.
8. McClaran SR, Harms CA, Pegelow DF, Dempsey JA. Smaller lungs in women affect exercise hyperpnea. J Appl Physiol (1985) 1998;84:1872-81.
9. Thurlbeck WM. Postnatal human lung growth. Thorax 1982;37:564-71.
10. Berad A, Lakshmi AN, Sneha P, Prasad D. Gender variation in lung function parameters in Indian adolescents. Int J Biol Med Res 2016;7:5414-6

11. Budhiraja S, Singh D, Pooni PA, Dhooria GS. Pulmonary functions in normal school children in the age group of 6-15 years in North India. Iran J Pediatr 2010;20:82-90.
12. Islam MN, Islam MN, Hoque MA, Latif SA, Mollah AH, Hossain MA, et al. Peak expiratory flow rate of normal school going children in Mymensingh municipality. Mymensingh Med J 2013;22:438-43.
13. Card JW, Zeldin DC. Hormonal influences on lung function and response to environmental agents: Lessons from animal models of respiratory disease. Proc Am Thorac Soc 2009; 6:588-95.
14. Rajput AS, Dwivedi SK, Agrawal AK, Goyal M. Gender-based comparative evaluation of pulmonary function tests. Indian J Clin Ana Physiol 2017; 4:51-4.
15. Dikshit MB, Raje S, Agrawal MJ. Lung functions with spirometry: An Indian perspective – I. Peak expiratory flow rates. Indian J Physiol Pharmacol 2005;49:8-18.
16. Dikshit MB, Raje S, Agrawal MJ. Lung functions with spirometry: An Indian perspective – II: On the vital capacity of Indians. Indian J Physiol Pharmacol 2005;49:257-70.
17. Wright BM, Mckerrow CB. Maximum forced expiratory flow rate as a measure of ventilatory capacity: With a description of a new portable instrument for measuring it. Br Med J 1959; 2:1041-6.
18. Chinn S, Jarvis D, Burney P; European Community Respiratory Health Survey. Relation of bronchial responsiveness to body mass index in the ECRHS. European community respiratory health survey. Thorax 2002; 57:1028-33.
19. Benjaponpitak S, Direkwattanachai C, Kraisarin C, Sasisakulporn C. Peak expiratory flow rate values of students in Bangkok. J Med Assoc Thai 1999;82 Suppl 1:S137-43.
20. Srinivas P, Chia YC, Poi PJ, Ebrahim S. Peak expiratory flow rate in elderly Malaysians. Med J Malaysia 1999;54:11-21.
21. Dharamshi HA, Faraz A, Ashraf E, Alam SS, Ali A, Shakeel O, et al. Variation of PEFR with height, weight, and waist-hip ratio in medical students. Int Arch Med 2015;8:1-6.
22. Pulickal AS, Fernandez GV. Peak expiratory flow rate in healthy rural South Indian school children predicted from body height. Indian J Public Health 2007; 51:117-9.2
23. Mishra J, Mishra S, Satpathy S, Manjareeka M, Nayak PK, Mohanty P. Variations in PEFR among males and females with respect to anthropometric parameters. J Dent Med Sci 2013; 5:47-50.
24. Azah N, Antai EJ, Peters EJ, Osim EE. Normal lung function values of Nigerian children aged 6-16 years. Niger J Physiol Sci 2002; 17:74-5.
25. John JM. Regression equations for peak expiratory flow rates for children (8-12 years) in Ernakulam District. Med J Dr. DY Patil Vidyapeeth 2018;11:3-8.
26. Carey IM, Cook DG, Strachan DP. The effects of adiposity and weight change on forced expiratory volume decline in a longitudinal study of adults. Int J Obes Relat Metab Disord 1999;23:979-85.
27. Shore SA. Obesity and asthma: Possible mechanisms. J Allergy Clin Immunol 2008;121:1087-93.
28. Ali MO, Begum S, Ali .T and Ferdousi .S, FVC, FEV1, and FEV1/FVC% in type 2 diabetes and their relationships with duration of the disease, J. Bangladesh Soc Physiol.,4(2), 2009 Dec, 81-87.
29. Kaur H, Singh J, Makkar M, Singh K, Garg R. Variations in the peak expiratory flow rate with various factors in a population of healthy women of the malwa region of punjab, India. J Clin Diagn Res 2013; 7:1000-3.0987654321r
30. Jena KS, Mirdha M, Meher P, Misra AK. Relation of peak expiratory flow rate to body mass index in young adults. Muller J Med Sci Res 2017; 8:19-23.