

RESEARCH ARTICLE

Peak flow meter and digital spirometer: A comparative study of peak expiratory flow rate values

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ABSTRACT

Background: Peak expiratory flow rate (PEFR) is one of the important and widely used lung function tests as it is very easy, reliable, and reproducible. PEFR is very sensitive and accurate index of airway obstruction and the strength of respiratory muscles. Many factors are known to affect its value such as age, sex, height, and body surface area, the normal range for males and females is 450–550 L/min and 320–470 L/min, respectively. PEFR can be determined using both peak flow meter and digital spirometer. Peak flow meter is a simple inexpensive handheld device; hence, it is relatively easy to measure PEFR by peak flow meter. The digital spirometers measure PEFR along with various other lung function parameters. It has been recorded in the previous studies that the PEFR values given by various peak flow meters and spirometer varies, in laboratory calibration tests, the error has been shown up to 26%. The present comparative study is undertaken to determine whether the PEFR values derived from peak flow meter and spirometer has any significant difference or not. **Aims and Objectives:** The objective of the study was to determine and compare the PEFR values using peak flow meter and digital spirometer. **Materials and Methods:** The study comprises 200 healthy male medical students in the age group of 18–25 years, conducted in the Department of Physiology, Bidar Institute of Medical Sciences, after obtaining ethical clearance from the Institutional Ethical Committee. The subjects will be instructed about the procedure for recording PEFR. All the subjects will be made acquainted with peak flow meter and spirometer before actual recording. PEFR will be recorded in sitting position. Three readings will be taken and the best among these will be taken as final value. **Results:** The mean PEFR measured by peak flow meter and spirometer was 338.7 ± 122.45 L/min and 299.6 ± 121.63 L/min, respectively. PEFR value is significantly greater when measured by peak flow meter than by spirometer ($P < 0.05$). **Conclusion:** Even though the values measured by both instruments vary, still the peak flow meters can still be advised for measuring PEFR in healthy individuals and daily monitoring of symptoms in asthma and chronic obstructive pulmonary disease patients as these are not very expensive, and procedure can be easily performed by all and repeated tests give almost same results.

KEY WORDS: Peak Expiratory Flow Rate; Digital Spirometer; Peak Expiratory Flow Rate Values

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INTRODUCTION

Peak expiratory flow rate (PEFR) is one of the important and widely used lung function tests as it is very easy, reliable, and reproducible. First time in 1942 Hardon said that PEFR can be used as a tool to determine the lung function that is ventilation, but only after few years, it was included as

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a part of regular spirometry.^[1] The PEFR is defined as the maximum velocity of flow with which air is forced out of the lungs and is expressed in L/min.^[2,3] The value of PEFR is affected by many factors few of them are age, anthropometry, sex, and race.^[4,5] The PEFR also depends on respiratory muscle power. It is going to determine the functioning of especially large airways, during the initial 100–200 ms of forced expiration.^[6,7] PEFR is very sensitive and accurate index of airway obstruction and the strength of respiratory muscles. Many factors are known to affect its value such as age, sex, height, and body surface area, the normal range for males and females is 450–550 L/min and 320–470 L/min, respectively.^[2]

The digital spirometers measure PEFR along with various other lung function parameters such as forced vital capacity (FVC), forced expiratory volume in 1 s (FEV1), breath holding time (BHT), and maximum voluntary ventilation (MVV). It has been recorded in the previous studies that the PEFR values given by various peak flow meters and spirometer varies, in laboratory calibration tests, the error has been shown up to 26%.^[3,8]

PEFR can be determined using both peak flow meter and digital spirometer. Peak flow meter is a simple inexpensive handheld device; hence, it is relatively easy to measure PEFR by peak flow meter. The volume of air respired can be measured by spirometry, it also records time taken and speed of air. Thus, it is one of the most important tests to determine the functioning of lungs. Spirometer is an objective test, detects the early changes and also not invasive.^[9] The digital spirometers measure PEFR along with various other lung function parameters such as FVC, FEV1, BHT, and MVV. The present comparative study is undertaken to determine whether the PEFR values derived from peak flow meter and spirometer have any significant difference or not.

Aims and Objectives

This study aims to determine and compare the PEFR values using peak flow meter and digital spirometer.

MATERIALS AND METHODS

This cross-sectional comparative study was conducted at Bidar Institute of Medical Science, in the Department of Physiology after obtaining ethical clearance from the Institutional Ethical Committee. For this study, 200 healthy male medical students in the age group of 18–25 years were selected. The subjects with a history of major respiratory, cardiac illness, or neurological disorders or with a history of major surgery or injury in the recent past, smoking, alcohol consumption, obesity, and pregnant females will be excluded from our study. Informed and written consent was taken from all the participants. After taking a detailed personal history,

anthropometric parameters such as height and weight were measured using standard methods and from this, body mass index was calculated. General physical and systemic clinical examination was done to rule out any pathology. All the recordings were done between 10 and 11 am to avoid diurnal variations.

The subjects were instructed about the procedure for recording PEFR. All the subjects were made acquainted with peak flow meter and spirometer before actual recording. PEFR was recorded in sitting position.

First, the PEFR was recorded using the mini-Wright's peak flow meter and the value was obtained in L/min. Three readings are taken at a time from each subject and the best among these is taken as final value. Similarly, for spirometry, Spirolab 3 computerized spirometer was used and the PEFR value is noted along with other values like FVC. It is also expressed as L/min.

Statistical Analysis

All results were expressed as mean \pm standard deviation SD. Student's paired *t*-test was used to analyze the data using the SPSS software. $P < 0.05$ was considered as statistically significant.

RESULTS

Our study comprised 200 healthy male medical students, aged between 18 and 25 years. Table 1 shows the anthropometry parameters of the subjects. The mean PEFR measured by peak flow meter and spirometer was 338.7 ± 122.45 L/Min and 299.6 ± 121.63 L/Min, respectively, as shown in Table 2. PEFR value is significantly greater when measured by peak flow meter than by spirometer ($P < 0.05$)

DISCUSSION

In the present study, the mean PEFR measured by peak flow meter and spirometer was 338.7 ± 122.45 L/min and 299.6

Table 1: Anthropometric parameters

Variables	Mean \pm SD
Height (m)	154.80 \pm 4.5
Weight (kg)	54.40 \pm 6.1
BMI (9 kg/m ²)	22.67 \pm 2.1

SD: Standard deviation, BMI: Body mass index

Table 2: Recording of PEFR by peak flow meter and digital spirometer

PEFR peak flow meter	PEFR spirometer	<i>P</i> value
338.7 \pm 122.45	299.6 \pm 121.63	<0.05

PEFR: Peak expiratory flow rate

± 121.63 L/min, respectively. The PEFr value recorded by peak flow meter was significantly high than the PEFr value recorded by spirometer. Similar studies have been done. One of the studies that go in accordance with our study was a study done by Tiwari *et al.*,^[10] which showed a high value of PEFr values in normal subjects and lower values in chronic obstructive pulmonary disease (COPD) patients and almost identical values in asthma patients, and there was no significant difference in the mean values of peak flow meter and spirometer. A similar study done by Takara *et al.*^[11] showed that the PEFr value obtained from peak flow meter was higher when compared to that obtained from spirometer, whereas the value from GaleMed meter was lower than the spirometric value. These differences in values were shown to be statistically significant.

However, few other studies do not show any significant difference in PEFr value measured by both instruments.^[12,13] A similar study done by Dr. Shubhi Thomar on comparison of PEFr values using peak flow meter and spirometer correlates with each other and the mean difference between PEF using peak flow meter and spirometer was statistically significant ($P < 0.05$).^[8]

This difference in PEFr value shows peak flow meters even though they are simple and cost effective, they cannot totally replace the spirometer for measuring PEFr, this does not mean that the peak flow meter performs poorly or not validated. Spirometer is used to diagnose asthma, determine its severity, and also helpful to monitor the progress of asthma. However, due of its high cost, it cannot be made available at all centers, especially in peripheries, even patients cannot use it for self-monitoring of symptoms. As our study was done on healthy individuals, there was difference in the value. Further study can be taken on asthmatic and those having COPD to know if the difference exists in them also or not.

PEFr being highly sensitive and an accurate index of airway obstruction and also an indicator to measure the strength of respiratory muscles, it would be preferably better to use device which is more handy, simple, reliable, and convenient to use. The peak flow meter is cost effective and patients can perform on own and can be made available in public and private health-care systems, compared to spirometry which is of higher cost and mainly it is available only in hospital set up and the patients need to go to hospital for every follow-up. In our study, limitation is that only Wrights peak flow meter was used and values are not compared with other type of peak flow meters available. The study was done on normal individuals and not on asthma or COPD patients.

CONCLUSION

Even though the value measured by both instruments varies, still the peak flow meters as they are not expensive, easy to handle, and perform, as it also gives consistent readings, therefore, it can be recommended for measuring PEFr in healthy individual and daily monitoring of symptoms in asthma and COPD patients.

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