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Original Research Article

An Analytical Cross-Sectional Study to Determine and Compare the PEFR Values using Peak Flow Meter and Digital Spirometer

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Abstract

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

Methodology: This analytical cross-sectional study was conducted at Shri Ramakrishna institute of medical sciences and Sanaka Hospital, Durgapur in the Department of Physiology after obtaining ethical clearance from the Institutional Ethical Committee. For this study, 100 healthy male medical students in the age group of 18–25 years were selected. 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. PEFR and spirometer was recorded in sitting position. All results were expressed as mean ± 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 100 healthy male medical students, aged between 18 and 25 years. The mean height and weight of participants were 160.64 ± 6.3 m and 52.56 ± 7.2 kg, respectively. The mean PEFR measured by peak flow meter and spirometer was 342.8 ± 118.46L/Min and 300.2 ± 130.34 L/Min, respectively. PEFR value is significantly greater when measured by peak flow meter than by spirometer ($P < 0.05$).

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

Keywords: Peak Flow Meter, Spirometer, Airflow, Respiration

Introduction

Peak expiratory flow rate (PEFR) measurement is beneficial in identifying and evaluating the airflow-limitation degree in epidemiological studies. In clinical practice, it

can be useful in monitoring the progress of disease and the effects of treatment [1, 2]. 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 a part of regular spirometry [3].

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 [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 [3, 8].

Spirometry is a commonly used test of lung function, an important tool in the diagnosis, and monitoring of respiratory diseases and is frequently used in epidemiological and clinical research [9]. Results of spirometry tests depend on several factors including technical factors such as the type of spirometer used, personal factors such as a subject's posture, and the cooperation between the subject and the technician, which need to be considered in clinical and epidemiological studies.

Spirometry is a basic test useful both for mea-suring and for monitoring lung function, includ-ing PEF [10]. 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]

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.

Materials and Methods

This analytical cross-sectional study was conducted at Shri Ramakrishna institute of medical sciences and Sanaka Hospital, Durgapur in the Department of Physiology after obtaining ethical clearance from the Institutional Ethical Committee.

For this study, 100 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, Spiro lab 3 computerized spirometer was used and the PEFR value is noted along with other values like FVC. It is also expressed as L/min. All results were expressed as mean ± 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 100 healthy male medical students, aged between 18 and 25 years. The mean height and weight of participants were 160.64 ± 6.3 m and 52.56 ± 7.2 kg, respectively. The mean PEFR measured by peak flow meter and spirometer was 342.8 ± 118.46L/Min and 300.2 ± 130.34 L/Min, respectively. PEFR value is significantly greater when measured by peak flow meter than by spirometer ($P < 0.05$).

Table 1: Anthropometric parameters

Variables	Mean±SD
Height (m)	160.64 ± 6.3
Weight (kg)	52.56 ± 7.2
BMI (kg/m2)	23.23 ± 3.5

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

PEFR peak flow meter	PEFR spirometer	P value
342.8±118.46	300.2 ± 130.34	<0.05

Discussion

Peak expiratory flow (PEF) is the maximum flow achieved during a forced expiration starting from the level of maximal lung inflation. In monitoring the progress of a disease and the effects of treatment it is important to measure PEF as it can identify and evaluate the degree of airflow-limitation [2]. Spirometry is the most widely used screening test for lung function or pulmonary function studies. It is usually the first test to be performed and interpreted.

Spirometry can be carried out in the ambulatory setting, physician's office, emergency department or inpatient setting. Electronic spirometry provides much more information about airway function while still providing PEF measurements. Invariably, peak expiratory flow measurement is carried out using a sophisticated spirometer using forced vital capacity maneuver in clinical setup. The patients' self-management strategies [11].

In the present study, the mean PEFR measured by peak flow meter and spirometer was 342.8±118.46 L/min and 300.2 ± 130.34 L/min, respectively. The PEFR value recorded by peak flow meter was significantly high than the PEFR value recorded by spirometer. One of the studies that go in accordance with our study was a study done by Tiwari *et al.* [12], 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* [13] showed that the PEFR value obtained from peak flow meter was higher when compared to that obtained from spirometer, whereas the value from Gale Med meter was lower than the spirometric value. These differences in values were shown to be statistically significant. Sly *et al* [14] in their study found that peak flowmeters do not only give inaccurate absolute values, but may also not be as effective as spirometers in tracking changes in lung function in children with asthma. The measurements are likely to differ depending on the brand of peak flowmeter used.

However, few other studies do not show any significant difference in PEFR value measured by both instruments [15, 16]. A similar study done by Dr. ShubhiThomar 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]

Various authors [8, 17-19] have expressed similar views in their study. This can be explained by the fact that asthma is a disease of larger airways and PEFR values represent primarily proximal airway caliber, whereas COPD mainly affects the smaller airways. The peak flow meter only measures the amount of airflow out of the large airways of the lungs and changes in airflow caused by the small airways will not be detected by it.

Conclusion

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

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