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Original Research Article

Peak Flow Measure: An Index of Respiratory Function?

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ABSTRACT

Aerodynamic analysis is interpreted as a reflection of the valving activity of the larynx. It involves measuring changes in air volume, flow and pressure which indicate respiratory function. These measures help in determining the important aspects of lung function. Peak expiratory flow rate is a widely used respiratory measure and is an effective measure of effort dependent airflow. Aim: The aim of the current study was to study the peak flow as an aerodynamic measure in healthy normal individuals
Method: The study group was divided into two groups with n= 60(30 males and 30 females) in the age range of 18-22 years. The peak flow was measured using Aerophone II (Voice Function Analyser). The anthropometric measurements such as height, weight and Body Mass Index was calculated for all the participants. Results: The peak airflow was higher in females as compared to that of males. It was also observed that the peak air flow rate was correlating well with height and weight in males. Conclusions: Speech language pathologist should consider peak expiratory airflow, a short sharp exhalation rate as a part of routine aerodynamic evaluation which is easier as compared to the otherwise commonly used measure, the vital capacity.

***Key words**: Peak expiratory flow rate, Height, Weight, Body mass Index, peak flow meter*

INTRODUCTION

Owing to the technological advancement over the past 30 years, the respiratory function testing has gained momentum as a clinical measure and is presently considered as an essential prerequisite to diagnose various obstructive and restrictive disorders of the respiratory system.

Respiratory function is measured by aerodynamic analysis of voice. This measurement involves changes with respect to the air volume, airflow and air pressure. Peak Expiratory Flow Rate is a widely used respiratory measure and is an effective measure of effort dependent airflow. It is the most commonly used to monitor the lung function. [1] Peak expiratory flow rate can be defined as the highest flow rate sustained by an individual for at least ten seconds. [2]

Spirometry is the widely used screening test for lung function. Invariably, the measurement of peak expiratory air flow is generally carried out using sophisticated spirometer using forced vital capacity maneuver in clinical setup. At home, the participants with chronic air flow obstruction who carry out their Peak

expiratory air flow measurement usually do so by using peak flow meters. The peak flow meter is one of the means of objectively assessing and monitoring the airway function. A peak flow meter is a small hand-held device that measures how fast a person can blow air out of the lungs when there is forceful exhalation, after maximum inhalation. The peak flow meter helps to assess the airflow through the airways and thus helps to determine the degree of obstruction along them.

The measurement of peak expiratory flow rate was pioneered by Wright who produced the first meter specifically designed to measure this index of lung function. Since the original design was introduced in the late 1950s, a more portable, lower-cost version, the 'Mini-Wright' peak flow meters have become available these days across the world. Certain softwares are also available for the measurement of respiratory function. The clinical significance of airflow, volume and pressure has been well documented in research. The instrument Aerophone II (Manufacturer: F.J. Electronics, Ellebuen 3 DK-290), offers a practical recording and analysing system for airflow measurements. It takes the advantage of a sophisticated combination of a hardware transducer system with transducers recording the aerodynamic signal, and a computerised data processing. The aerophone II includes the measurements of respiratory parameters (peak flow, vital capacity, forced 1 second expiration and duration), sustained phonation parameters(minimum, maximum and average sound pressure level, dynamic range, volume of air used, mean flow rate, phonation duration and quotient), speech parameters (sound pressure level, air pressure and airflow during running speech and duration),voice parameters(voice range profile), voice efficiency parametres (subglottal pressure, glottal resistance, glottal aerodynamic input power, acoustic output power and glottal efficiency), and velocity of articulation (registration of adduction, Abduction rate of the glottis, tongue or the velum as movements per second).

The peak expiratory flow rate basically provides information regarding the force of the contraction of the expiratory muscles of respiration. Peak expiratory flow rate has been well correlated to maximum expiratory pressure which is a representation of respiratory muscle strength. [3] The higher the value, the stronger and more sudden is the contraction of expiratory muscles of respiration. The peak expiratory flow is measured in ml/second. In an individual whose lungs have not been affected by any pathological condition, the factors affecting peak expiratory flow rate are the dimensions of the large intra and extrathoracic airways, [4] the force generated by the expiratory muscles, the speed with which maximal alveolar pressure is reached, [5] and how the lung was stretched prior to the Peak expiratory flow rate manoeuvre. There is also research evidence that exercise training increases the peak expiratory flow rate because of an increase in respiratory muscle strength. The Peak expiratory flow rate is an effort dependent parameter emerging from the large airways within about 100–120 ms of the start of the forced expiration. [6] Peak flow rate is higher in physically fit or, healthier population such as Armed forces personnel and Athletes. [7]

Need for the study

The measurement of peak expiratory flow rate is useful in the clinical assessment of airway obstruction. It is one of many tests that measure how well airways are functioning. Speech language pathologists usually consider vital capacity as a sole measure in the evaluation of respiratory function. The research focus on the peak airflow as an aerodynamic measure in Indian

scenario is sparse. There have been no reports of studies on peak expiratory flow rate for Indian population using Aerophone II analyser. Hence, this investigation was undertaken with an objective of determining peak expiratory flow rate in Indian young adults.

The aim of the current study was to study the peak flow as an aerodynamic measure in healthy individuals with objectives to study peak air flow rate measure range in young healthy adults, to determine the effect of height, weight and body mass index on peak air flow rate and to compare across the gender.

MATERIALS AND METHODS

This study was conducted in a multidisciplinary hospital and was approved by the Institutional Ethical Committee. The study followed a cross sectional design with convenient sampling.

***Participants*:** The participants were divided into 2 groups. Group 1 consisted of n=30 young males in the age range of 18- 22 years. Group 2 consisted of n=30 young females in the age range of 18 to 22 years. The mean age of the male participants was 21.3 (± 1.09) years and the mean age of the female participants was20.27 (±1.015) years. All participants were free of cardiovascular disease, diabetes, cancer, respiratory diseases, smoking and any surgery/ skeletal abnormality likely to affect lung functions. The anthropometric measurements such as height, weight and Body Mass Index (BMI) was calculated for all the participants. Body Mass Index was calculated from measured values of height and weight by the equation BMI = weight (kg)/height2 (m2).The Body Mass Index was categorized as per the WHO (World Health Organization) recommendations.

***Instrumentation*:** The data was collected using Aerophone II (Voice Function Analyser)

Manufacturer: F.J. Electronics, Ellebuen 3 DK-290, Denmark.

***Procedure*:** The test procedure was explained to the participants and a demonstration of maneuver was given to each of them. The participants were asked to remain in relaxed seated position. The participants were asked to hold the peak flow meter horizontal to their mouth, take in a deep breath, make a tight seal with their lips around the mouth tube, and asked to blow out as hard and fast as they could in one breath. They were requested to take a deep breath and exhale as forcefully as possible in one single blow into the instrument. A short sharp breath was instructed rather than a prolonged forceful breath. Two satisfactory readings were taken and highest of the two was taken for further analysis. The obtained data was analysed with SPSS software.

RESULTS

In the present study, peak airflow was investigated in young males and females and was correlated with respect to their height and weight. Descriptive statistics were employed to find out mean and standard deviation of peak airflow measure. It was observed that peak airflow was higher in females as compared to that of males. There was significant difference observed between the two groups at $p<0.001$. In the present study, the participants were divided into 2 groups for height (140-165 centimeters; 166-190centimetres) and weight (40-70 killograms; and 71-100killograms). Body mass index was also calculated for all the participants. It was also observed that females did not demonstrate difference in the peak flow measures among the normal weight and overweight group, but the participants with underweight had reduced peak airflow. Whereas in male participants, it was observed that the more the height, the

better was the peak flow and more the weight more the peak airflow measure was correlating with both height and weight. All the participants performed better in the 2nd trail when compared to the first trial.

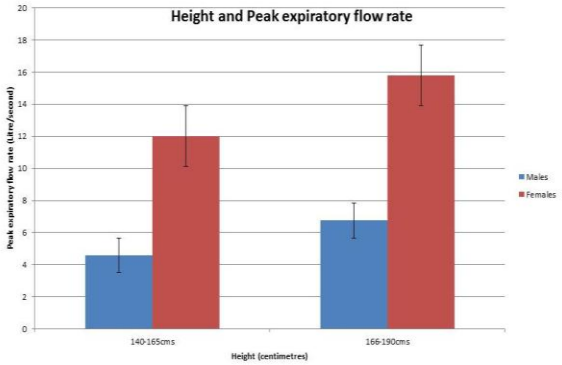

Figure 1 shows the mean and standard deviation of peak expiratory flow rate in participants grouped according to their height

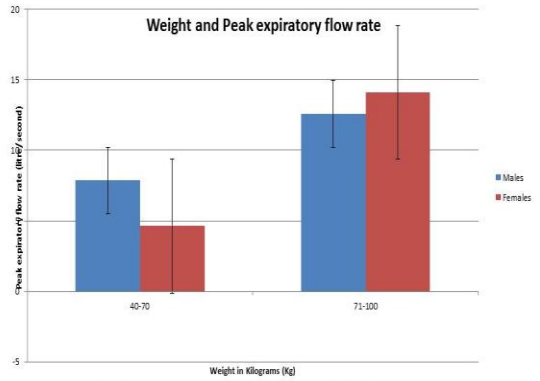

Figure 2 shows the mean and standard deviation of peak expiratory flow rate in participants grouped according to their weight

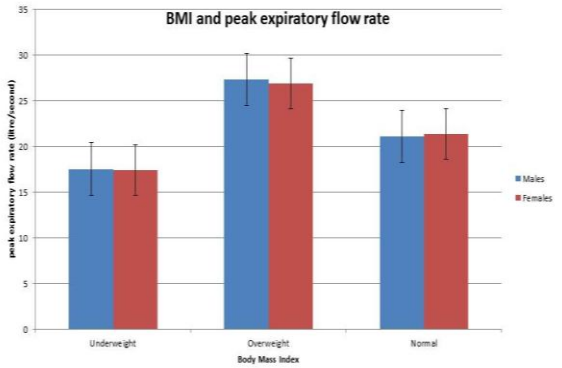

Figure 3 shows the mean and standard deviation of peak expiratory flow rate in participants grouped according to their Body mass Index

DISCUSSION

Pulmonary function tests are one of the indicators of the health status of the individuals and could be used as a tool in general health assessment. The respiratory measure, peak expiratory flow rate plays an integral role in the assessment and management of airway disorders. It is influenced by several anthropometric factors such as height, weight, chest circumference and body surface area. [8]

In the present study, the peak flow was higher in females compared to males. Generally, up to about 13–15 years of age boys produce the same peak expiratory flow rate as girls of corresponding stature and age, since the greater muscular power is probably off set by narrower airways. [9] However, another study reported of males achieving a peak at about 23–25 years of age, maintain this level up to about 30 years, and thereafter their Peak expiratory flow rate starts to decline. Females appear to achieve maximum flow a little before 20 years, and appear to maintain that level for almost 2decades. [10] The relatively prolonged maintenance of peak values in females seems to coincide with their reproductive life. Prevalence of female sex hormones may also be responsible for this phenomenon. This observation holds good for explaining the results of our study since the age group considered for the study was 18-21 years.

With reference to the height it was observed that the peak expiratory flow rate increased with the increase in height among the participants. This observation was consistent with the findings of the earlier studies. [11,12] This was probably because of the greater chest volume in the taller participants. It was also observed that there was better correlation between peak expiratory flow rate and height in females as compared to that of males.

In the present study, it was observed that peak expiratory flow rate was correlating with weight among both the participant groups. The peak expiratory flow was higher in females as the weight increased. There are several studies reported on positive correlation between the peak air flow rate and obese group. With increasing obesity, fat deposition tends to occur centrally (both around the trunk and intraabdominally), which may likely affect the airflow. But in our study we had no participants who could be enrolled to the obese group. However we have found that the peak expiratory flow rate was lower in underweight group participants compared to the overweight and normal weight. Earlier studies have reported changes in serum leptin levels with underweight. [13] According to preliminary results, leptin may have pro inflammatory effects in the airways and may affect bronchial reactivity, and hence the peak flow is reduced in people who are underweight. It is also important to understand that reduction in weight significantly slows the decline in lung function. [14,15] Studies evaluating the effect of overweight on pulmonary function have produced variable results. This may be because of different criteria for measuring obesity, numbers of subjects, and different degrees of obesity. [16] However in our study we have found slight difference between the normal and the overweight participants.

CONCLUSION

Peak expiratory flow rate should be considered as a part of routine aerodynamic evaluation. The advantage of this over the other regularly used measure vital capacity is that this parameter is effort dependent, and the forced expiration is not required to be extended to residual volume. There are portable peak flow meters available, which can also be used on a daily monitoring basis especially in individuals with any respiratory distress and also can be utilised for bedside assessment. The instructions for performing the peak expiratory flow rate manoeuvre are more easily understood by the subject/patient as compared with the directions for performing the forced expiratory one. Moreover this measure is sensitive in the identification of deviations in the lung function.

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