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Original research article

A study of peak expiratory flow rate in patients attending to a tertiary care hospital

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Abstract

Background: Spirometry is a gold standard evaluation tool for determining an individual's lung function. It measures the amount of air inhaled and exhaled by a person in a given amount of time.[1] It is useful for detecting obstructive and restrictive airway diseases, quantifying the degree of impairment or severity, assessing prognosis and operative risks, assessing health status prior to enrolment in a rehabilitation program, monitoring the effects of various environmental exposures, and studying the effect of drugs and treatment on pulmonary functioning [2].

Objectives

- To determine the PEFR levels in the study population.
- To find out the PEFR levels in different age groups in the study population.
- To find out the gender wise variations in PEFR levels in the study population.

Material & Methods

Study design: Hospital based prospective cross-sectional study.
Study period: 1 year.
Study population: Patients attending to General Medicine with respiratory symptoms.
Sample size: Study consisted a total of 1200 subjects.
Sampling technique: Simple Random technique.
Inclusion criteria: Individuals who were 15 and above 15 years of age of both genders were included.
Study tools and data collection procedure: Weight was measured in kilograms without footwear. Height was measured in centimetres without footwear. Body surface area was determined by DuBois body surface area chart. PEFR was measured using mini wright peak flow meter high range model i.e.; range from 60-800 L/min. Before the test, the subjects were demonstrated how to use MWPFM correctly. Then three readings were taken in standing position. The gap between each reading was five minutes. Out of the three readings the highest reading was taken as the subjects PEFR value. Instrument mini wright peak flow meter that was used for this study.
Results: The average PEFR in healthy young males (21-40 years) was about 518 ± 53.4 L/min and the least values were for above 50 years age group i.e.; 392 ± 59.5 L/min. In female population, the highest PEFR values were in 21-40 years age group i.e.; 351± 38.9 L/min and the lowest was in the age group above 50 years i.e.; 266 ± 49.7 L/min.
Conclusion: From the present study, it can be concluded that, Gender, age and height were the significant determinants of PEFR in the healthy population group. There is a significant difference of PEFR values in males and females. PEFR shows a linear relationship with height in both males and females. PEFR is a simple yet effective tool for epidemiological surveys as it takes short time to perform and does not requires electric power and a spot reading can be directly taken from the dial of the instrument.
Keywords: Peak expiratory flow rate, spirometry, pulmonary functioning

Introduction

Spirometry is a gold standard evaluation tool for determining an individual's lung function. It measures the amount of air inhaled and exhaled by a person in a given amount of time.[1]It is useful for detecting obstructive and restrictive airway diseases, quantifying the degree of impairment or severity, assessing prognosis and operative risks, assessing health status prior to enrolment in a rehabilitation program, monitoring the effects of various environmental exposures, and studying the effect of drugs and

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treatment on pulmonary functioning [2].

Because of the rising prevalence of respiratory disorders, air pollution, and cigarette smoking, spirometric examination has become more popular in recent years [3]. However, the use of spirometry necessitates the use of expensive spirometric equipment and a competent technician to operate it, which may not be available at an emergency department or during screenings for large populations and mass casualties. As a result, simple, low-cost alternatives to spirometry were developed for use in similar situations. These alternative bedside evaluation techniques are affordable, simple to teach, learn, and apply and reproducible [4].

They include, among other things, the cough test, wheeze test, Debono's whistle test, Snider's match blow test, breath holding duration test, and single breath count [5-8]. The peak expiratory flow rate (PEFR) is the maximum expiratory flow rate that occurs following a maximal inhalation. It is sustained for at least 10 milliseconds of exhalation and is measured in litres per minute (L/min) using a simple, portable hand-held flow gauge instrument called the peak flow meter [9]. It is indicative of airway calibre, respiratory muscle strength, and voluntary effort. It is commonly used in the diagnosis and monitoring of asthma, detecting triggers and evaluating therapy response [10].

Objectives

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- To find out the gender wise variations in PEFR levels in the study population.

Material & Methods

Study design: Hospital based prospective cross-sectional study.
Study area: Department of Physiology and General Medicine, Siddhartha medical college, Vijayawada, Andhra Pradesh.
Study Period: 1 year.
Study population: Patients attending to General Medicine and Pulmonology with respiratory symptoms.
Sample size: Study consisted a total of 1200 subjects.
Sampling technique: Simple Random technique.
Inclusion criteria: Individuals who were 15 and above 15 years of age of both genders were included.

Exclusion criteria

- Individuals with history of respiratory diseases like to bronchial asthma, pleural diseases, collapse of lung, fibrosis of lung, chronic bronchitis were excluded.
- Individuals who had deformities of vertebral column like kyphosis, scoliosis were excluded.
- Obese individuals were excluded.
- Chronic smokers were excluded.
- Pregnant women were excluded.

Ethical consideration: Institutional Ethical committee permission will be taken prior to the commencement of the study.

Study tools and data collection procedure

Weight was measured in kilograms without footwear. Height was measured in centimetres without footwear. Body surface area was determined by DuBois body surface area chart. PEFR was measured using mini wright peak flow meter high range model i.e.; range from 60-800 L/min. Before the test, the subjects were demonstrated how to use MWPFM correctly. Then three readings were taken in standing position. The gap between each reading was five minutes. Out of the three readings the highest reading was taken as the subjects PEFR value. Instrument mini wright peak flow meter that was used for this study.

Procedure to measure peak expiratory flow rate using mini wright peak flow meter

- Fit the mouthpiece to the peak flow meter.
- Ensure the pointer is set at zero liters per minute position.
- Loosen any tight clothing that might restrict the breathing.
- Ask the subject to stand straight.
- Ask the subject to hold the Mini Wright peak flow meter such that his or her fingers are clear of the scale and do not obstruct the holes at the end of the instrument.
- Ask the subject to take a deep breath and purse the mouthpiece of the instrument tightly enough with his or her lips.
- Then ask the subject to blow air into instruments ‘mouthpiece as forcefully and as fast as possible.
- During the test, the subject should be careful that no air leaks out through their pursed lips.
- When subject blows air through mouthpiece, the piston moves forward and pointer also moves

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forward maximally with maximum effort and coincides with the scale.

- Then the reading on the scale at which the pointer stops is noted down.
- Slide back the pointer to zero liters per minute and repeat the procedure two more times.
- Note the highest of the three readings as the PEFR of that Individual.

Maintenance of the Peak Flow Meter

The instrument used in the study was cleaned regularly after everyday use by the following procedure.

- First rinse the instrument by potassium permanganate solution.
- Then immerse it into warm, mild detergent solution for 2-3 minutes.
- Rinse in clean warm water and shake gently to remove any excess water.
- Allow to dry thoroughly before using again.
- Sterilizable plastic mouthpieces were cleaned after every use by the same procedure as mentioned above.

Statistical Analysis

The study design is cross-sectional and prevalence study. Most of the variables used in our study are categorical. Hence frequency and prevalence were calculated. Pearson's chi-square test also known as the Chi-square test for independence and the Chi-square test of association was used to detect if there was any relationship between two categorical variables. ANOVA was used to compare the two means. A p-value of 0.05 is taken as significant.

Observations & Results

The study population included 2400 subjects out of which 1200 were males and 1200 were females. The age of the subjects was from 15 to 79 years. They were randomly selected and examined for their PEFR if they fulfilled the selection criteria. In the total subjects, PEFR value ranges from 200 L/min to 620 L/min. In males the range is from 250 L/min to 620 L/min and in females 200 L/min to 420L/min.

Table 1: Peak Expiratory Flow Rate (Litre/Min) Values for Females & Males in Relation to Age Groups

Groups		Females N	Female Mean ± SD	Male N	Male Mean ± SD	P Value
Age Years	15-20	236	360.36±40.9	317	462.32±69.76	0.00
	21-30	256	351.37±38.9	175	486.13±71.9	0.00
	31-40	164	338.51±34.6	176	518.98±53.4	0.00
	41-50	144	339.38±32.2	132	514.85±54.8	0.00
	51-60	188	266.41±49.7	260	392.43±59.5	0.00
	>61	212	268.18±49.4	140	394.69±56.7	0.00
	Total	1200		1200		

Results expressed as Mean ± SD; Post-hoc Sheffe's alpha test one way ANOVA was used. P value is considered significant at 0.05% level.

Table 2: Peak Expiratory Flow Rate (Litre/Min) Value for Females & Males in Relation to Weight Groups

Groups		Females N	Female Mean ± SD	Males N	Male Mean ± SD	P Value
Weight in Kgs	41-50	188	360.16±40.7	-	-	-
	51-60	1000	315.23±57.3	368	459.80±72.4	0.00
	61-70	12	283.08±46.6	764	460.37±82.9	0.00
	71-80	-	-	68	401.32±54.8	-
	Total	1200		1200		

Results expressed as Mean ± SD; Post-hoc Sheffe's alpha test one way ANOVA was used. P value is considered significant at 0.05% level.

Table 3: Peak Expiratory Flow Rate (Litre/Min) Value for Females & Males in Relation to Body Surface Area

BSA(m^2) Groups	Females N	Female Mean ± SD	Male N	Male Mean ± SD	P Value
1.30-1.65	1088	327.39±55.3	118	466.29±68.2	0.00
1.66-2.00	112	268.93±49.3	1082	455.82±80.7	0.00
Total	1200		1200		

Results expressed as Mean ± SD; Post-hoc Sheffe's alpha test one way ANOVA was used. P value is considered significant at 0.05% level.

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Table 4: Peak Expiratory Flow Rate (Litre/Min) Value for Females & Males in Relation to Height in 21 to 40 Years Age Group

Groups		Females N	Female Mean ± SD	Male N	Male Mean ± SD	P Value
Height in cms	141-150	32	314.37±42.2	-	-	-
	151-160	316	359.93±52.5	15	481.33±79.9	0.00
	161-170	72	357.5±49.3	200	525.5±72.4	0.00
	171-180	-	-	136	548.52±71.4	-
	Total	420		351		

Results expressed as Mean ± SD; Post-hoc Sheffe's alpha test one way ANOVA was used. P value is considered significant at 0.05% level.

Discussion

In this study, Peak expiratory flow rate was recorded in 2400 healthy individuals in the age ranging from 15-79 years of both genders. The variations in PEFR with various factors like age, height, weight, body surface area were studied. The relationship of PEFR in different age groups was analyzed. It was found that the mean PEFR value in all male age groups was greater than the females of same age group. The results were found to be statistically highly significant. As PEFR is an effort driven test, this difference in males and females may be attributed to greater muscle mass in males and their airways diameter which are larger.

From the mean PEFR values it was seen that the males achieve a peak at about 18-24 years of age, and maintain this level upto 40 years, and thereafter it declines with advancing age. The average PEFR in healthy young males (21-40 years) was about 518 ± 53.4 L/min and the least values were for above 50 years age group i.e.; 392 ± 59.5 L/min. In female population, the highest PEFR values were in 21-40 years age group i.e.; 351± 38.9 L/min and the lowest was in the age group above 50 years i.e.; 266 ± 49.7 L/min. This results were similar to the findings mentioned by Dikshit *et al.* [11], in their article lung functions with spirometry: an Indian perspective-I. Peak expiratory flow rates and Singh H.D [12].

There may be a decline in PEFR values in the elderly subjects because PEFR is dependent upon expiratory muscle effort, lung elastic recoil and airway size [13] and these factors are known to decrease with advancing age [14]. So PEFR can be used for a bedside assessment of elderly patients with respiratory problems [15]. Therefore, it can be stated that PEFR shows a curvilinear relationship with age in both sexes as it increases upto 40 years and then starts declining with advancing age. PEFR in males was more than those in females. The highest values for males were seen in weights between 51 to 70 kgs i.e.: 460 ± 72.4 L/min and least values were seen in the weight group of 71-80 kgs. In females the highest PEFR values were seen in weight group of 41-50 kgs. and lowest values were seen in weight group of 61-70 kgs. i.e.; 283.08 ± 46.6 L/min.

The PEFR values were more in males compared to that in females. The mean PEFR value in males were almost similar in both the BSA groups taken i.e.; 466.29±68.2 L/min.in 1.30-1.65 m^2 group and 453.28 ± 80.7 m2 in group of 1.66-2.00 m^2. In females the mean PEFR value was more in group of 1.30-1.65m2 i.e.; 327.39 ± 68.2 L/min. compared to that in the group of 1.66-2.00m^2. PEFR in relation to height in subjects between ages of 21-40 years, there was positive correlation of PEFR with height in the study subjects. In males the highest value was seen in those subjects with heights above 171 cms with highest PEFR mean value of 548.52 ± 71.4 L/min and least value was found in height below 160 cms. Similar relation was seen in females with relation to height. Therefore, it can be concluded that PEFR increases with increase in height. This observation was consistent with the findings of the other similar studies done by Harpreet Kaur *et al.* [16], in Punjab region, H.D. Singh *et al.* [12], who conducted studies in South Indians. This correlation with height is probably due to greater chest volume in taller subjects.

Conclusion

From the present study, it can be concluded that, Gender, age and height were the significant determinants of PEFR in the healthy population group. There is a significant difference of PEFR values in males and females. PEFR shows a linear relationship with height in both males and females. PEFR is a simple yet effective tool for epidemiological surveys as it takes short time to perform and does not requires electric power and a spot reading can be directly taken from the dial of the instrument.

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