Original Research Article

Peak expiratory flow rate in children aged 6 to 14 years

A. Gunasekaran*

Department of Pediatrics, Shri Sathya Sai Medical College and Research Institute, Sri Balaji Vidyapeeth University, Chennai, Tamil Nadu, India

Received: 26 June 2021

Accepted: 01 July 2021

***Correspondence:**

Dr. A. Gunasekaran,

E-mail: drguna1283@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial

ABSTRACT

Background: The objective of this study was to record the PEFR values in children aged between 6 to 14 years.

Methods: A cross sectional study was conducted among 1205 children aged 6 to 14 years in department of paediatrics at a medical college hospital. In a pre-structured questionnaire, the age, sex and PEFR values were recorded. PEFR was considered as primary outcome variable. SPSS version 20 was used for data analysis.

Results: Total of 1205 children, 51% were boys and 49% were girls. Ninety children of age 6 years ranged between 60 to 200 with 111.1 ± 29.4 and 7 years ranging from 70 to 210 with 136.3 ± 30.5 . One hundred and five of age 8 years had 156.9 ± 33.3 ranging from 90 to 230 and 126 of age 10 years with 195.7 ± 38.8 ranging from 110 to 290. Mean PEFR for boys increased with their age and was greater than girls.

Conclusions: The overall mean PEFR values for the age group 6 to 14 years was 225 ± 90.07 l/min. Boys have higher PEFR value than girls of the same age group. Hence, PEFR values in this study can be used clinically as reference value for children aged 6 to 14 years.

Keywords: Pulmonary function tests, Children, Peak flow rates, Age, Sex

INTRODUCTION

Many chronic pulmonary diseases of childhood that are frequently encountered result in varying degrees of obstruction to the flow of air within the tracheobronchial tree. Hence, for assessing functional derangement and for evaluating the results of various therapeutic regimens, efficient techniques are required; estimation of the severity of airway obstruction is vital. Direct measurement of airway resistance is frequently used in physiologic studies.¹ However, the procedure is not practical for routine clinical use. In recent times, the measurement of peak expiratory flow rates (PEFR) has been shown to be useful as an indirect index of airway obstruction.

Peak expiratory flow is the maximum flow rate generated during a forceful exhalation, starting from full lung inflation. It primarily reflects large airway flow and depends on the voluntary effort and muscular strength of

the subject.² The peak flow meter is a useful instrument for monitoring PEFR.

It can be used in healthy children and adults. This procedure is easy to learn, simple to perform, and is reproducible. The main factors affecting PEFR are: age, sex, weight, and height.³ Numerous studies report that geographical, climatic, anthropometric, socioeconomic conditions, and nutrition in different parts of India are associated with regional differences in lung function.⁴ Therefore, ideally speaking, all the Indian states and geographical regions as well as communities must have their own separate norms for these parameters. Although, many studies have evaluated the PEF values in the children from various regions in India, but their results cannot be extrapolated to children at Chennai due to varied cultural, custom and environmental factors.

The aim of this study was to record the PEFR values among children aged 6 to 14 years and to find out whether the results can be used clinically as reference values.

METHODS

A cross sectional study was conducted at the department of paediatrics in a medical college hospital from 2013 to 2014. Institutional human ethical committee clearance was obtained and informed written consents were signed by parents or guardians of the children. Healthy school going children aged 6 to 14 years of both sexes were included in the study. Children with history of cough, cold, fever for past 2 weeks, wheezing in the past or asthma, any significant drug intake in the past 1 week, history of exercise induced asthma in the past, those with other systemic illness and children with muscular weakness, severe pallor, clubbing, cyanosis, pedal edema, chest and spine abnormalities were excluded from this study.

The recruitment of the children was done from the schools of the district. Approval from education authorities were obtained. A total of 1205 children (618 boys and 587 girls) were recruited for the study. The sampling technique followed was random sampling. Age was taken as per the completed years as on the school records. The children were subjected to full clinical assessment. PEFR was measured by EU scale peak flow meter (60-800 l/min). It was a plastic cylindrical tube graduated scale on the surface and a mouth piece. Graduation starts with 60 l/min to 800 l/min with accuracy of 10 l/min. Indicator of PEFR remains in place of reading unless brought back manually by the operator. All the measurements of PEFR are taken in the standing position.

The purpose of the test and procedure was explained to the children. Then the procedure was demonstrated in detail so as to familiarize them with the procedure and to get their full cooperation. Each child was told to take a deep breath and then blow into peak flow meter as hard and as fast possible through mouth piece and was closely watched to ensure that he/she maintained an air tight seal between the lungs and the mouth piece of the instrument. The procedure was repeated thrice and the highest value of these 3 readings was taken as the observed PEFR. Disposable mouth pieces were used for recording the PEFR.

Statistical analysis

PEFR was considered as primary outcome variable. Age and sex were considered as explanatory variables. Descriptive statistics was done by mean and standard deviation for continuous variables and for categorical variables frequency and proportions were used.

Regression analysis was done to study the relationship between primary explanatory and outcome variables. SPSS version 20 was used for statistical analysis.

RESULTS

Total of 1205 children, 51% were boys and 49% were girls (Figure 1). Majority of boys 128 (20.7%) and 94 (16%) girls of age 11 years and 117 (18.9%) boys and 84 (14.3%) of 12 years is presented in Figure 2.

Figure 1: Pie chart of sex distribution.

Figure 2: Age and sex distribution of study participants.

Table 1 presents the descriptive statistics of PEFR for different age and sex. It also shows that Mean PEFR for boys increased with their age and was greater than girls. Ninety children of age 6 years ranged between 60 to 200 with 111.1 ± 29.4 and 7 years ranging from 70 to 210 with 136.3 ± 30.5 . One hundred and five of age 8 years had 156.9 ± 33.3 ranging from 90 to 230 and 126 of age 10 years with 195.7 ± 38.8 ranging from 110 to 290. We observed a majority of 222 students of age 11 years with 206.4 ± 33.1 ranging from 130 to 300 and 201 students of age 12 years with 219.0 ± 37.1 ranging from 120 to 400. We had equal number of 140 students of age 13 years with 340.1 ± 40.2

and of 14 years with 382.7 ± 55.7 ranging from 200 to 520 as observed in Table 2. From Table 3, shows the mean PEFR (mean $\pm$ SE) for 618 boys was 236.3 ± 96.7 and 213.3 ± 80.9 for 587 girls. The overall PEFR of 1205 children was 225.1 ± 90.7 ranging from 60 to 520. From Table 4, the linear regression model for boys of all age shows, one-year increase in age, there was 33.03% increase in PEFR with a constant (-115) and a 95%

confidence interval 31.1 to 34.9, a lesser $R^2=66.1\%$ which was found to be statistically significant. The linear regression model for girls of all age shows, one-year increase in age, there was 28.3% increase in PEFR with a constant (-83.2) and a 95% confidence interval 26.8 to 29.7, a lesser $R^2=71.2\%$ which was found to be statistically significant.

Table 1: Descriptive statistics of PEFR for age and sex.

Sex	Age (years)	Frequency	Mean PEFR	SD	Minimum	Maximum
Boys	6	46	119.78	29.25	70.00	200.00
	7	48	137.92	31.15	70.00	210.00
	8	50	160.80	32.50	90.00	230.00
	9	32	199.38	30.37	150.00	270.00
	10	57	207.72	44.28	120.00	290.00
	11	128	210.55	31.46	130.00	290.00
	12	117	223.03	37.18	150.00	400.00
	13	70	357.14	36.80	280.00	460.00
	14	70	422.86	36.64	330.00	520.00
Girls	6	44	102.05	27.16	60.00	190.00
	7	42	134.52	30.14	80.00	200.00
	8	55	153.45	34.01	100.00	220.00
	9	59	176.27	27.79	100.00	250.00
	10	69	185.94	30.65	110.00	240.00
	11	94	200.96	34.67	140.00	300.00
	12	84	213.45	36.59	120.00	350.00
	13	70	323.14	36.38	200.00	420.00
	14	70	342.71	40.75	200.00	420.00

Table 2: Descriptive statistics of PEFR for all children of different age.

Sex	Age (years)	Frequency	Mean PEFR	SD	Minimum	Maximum
All	6	90	111.11	29.47	60.00	200.00
	7	90	136.33	30.55	70.00	210.00
	8	105	156.95	33.34	90.00	230.00
	9	91	184.40	30.63	100.00	270.00
	10	126	195.79	38.83	110.00	290.00
	11	222	206.49	33.12	130.00	300.00
	12	201	219.03	37.14	120.00	400.00
	13	140	340.14	40.25	200.00	460.00
	14	140	382.79	55.75	200.00	520.00

Table 3: Shows mean PEFR for boys and girls and both sexes together.

Sex	Frequency	Mean PEFR	SD	Minimum	Maximum
Boys	618	236.30	96.74	70.00	520.00
Girls	587	213.36	80.90	60.00	420.00
All	1205	225.12	90.07	60.00	520.00

Table 4: Regression model summary of boys and girls for all ages.

Sex	Constant	Beta	95% CI for Beta		P value	R	R ²	Adj R ²
			Lower	Upper				
Boys	-115.04	33.039	31.167	34.911	<0.001*	0.813	0.661	0.661
Girls	-83.26	28.307	26.844	29.770	<0.001*	0.844	0.712	0.711

*Statistically significant.

DISCUSSION

Assessment of lung function is a vital part of respiratory medicine in both healthy individuals and diseased patients. PEFR is an effort-dependent parameter. It emerges from the large airways within about 100-120 m/s of the start of forced expiration and remains at its peak for 10 m/s.⁵ Recently, PEFR has been gaining importance and has become a widely used method for the evaluation of obstructive and restrictive diseases.⁶

As there are many sources of variation in pulmonary function each region should have its own value. Some of the factors that cause intraindividual variation are: airway resistance, maximal voluntary effort, and the possible compressive effect of the maneuver on thoracic airways.⁷ Additionally, geographical factors, exposure to environmental and occupational pollutions, and socioeconomic status can also influence intraindividual variation.⁸ Factors that cause interindividual variation are: height, weight, age, race, and past and present health. The present study was conducted among 1205 children aged between 6 and 14 years to measure and record their PEFR values so that they can be used as reference values for children of that age group. The results showed that the overall mean PEFR values was 225 ± 90.07 l/min. Also, boys had higher PEFR value than girls of the same age group. It was also found that mean PEFR for boys increased with their age and was greater than girls.

The limitations of the current study were its cross-sectional nature and comparatively less sample size. Large scale multicentric studies involving huge population are recommended in future to develop a uniform database.

CONCLUSION

PEFR values in this study can be used clinically as reference value for children aged 6 to 14 years. These PEFR values can be used by clinicians in assessing the lung function and air way obstruction in this population subset.

ACKNOWLEDGEMENTS

We would like to acknowledge the work of the department staff and school authorities for their help.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Dubois AB, Botelho SY, Comroe JH. A new method for measuring airway resistance in man using a body plethysmograph: values in normal subjects and in patients with respiratory disease. *J Clin Invest.* 1956;35(3):327-35.
2. Enright PL, Linn WS, Avol EL, Margolis HG, Gong H, Peters JM. Quality of spirometry test performance in children and adolescents: experience in a large field study. *Chest.* 2000;118(3):665-71.
3. Cotes JE. Assessment and Application Medicine. In: Leathart GE, Pearse SJ, eds. *Lung function.* 5th ed. Hoboken, NJ: Blackwell Scientific Publication; 1993: 474-482.
4. Raju PS, Prasad KV, Ramana YV, Ahmed SK, Murthy KJ. Study on lung function tests and prediction equations in Indian male children. *Indian Pediatr.* 2003;40(8):705-11.
5. Dikshit MB, Raje S, Agrawal MJ. Lung functions with spirometry: an Indian perspective--I. Peak expiratory flow rates. *Indian J Physiol Pharmacol.* 2005;49(1):8-18.
6. Manjunath CB, Kotinatot SC, Babu M. Peak expiratory flow rate in healthy rural school going children (5-16 years) of Bellur region for construction of nomogram. *J Clin Diagn Res.* 2013;7(12):2844-6.
7. Swaminathan S, Venkatesan P, Mukunthan R. Peak expiratory flow rate in south Indian children. *Indian Pediatr.* 1993;30(2):207-11.
8. Chong E, Ensom MH. Peak expiratory flow rate and premenstrual symptoms in healthy nonasthmatic women. *Pharmacotherapy.* 2000;20(12):1409-16.

Cite this article as: Gunasekaran A. Peak expiratory flow rate in children aged 6 to 14 years. *Int J Contemp Pediatr* 2021;8:1362-5.