

Pediatric Peak Expiratory Flow Rates Nomogram for Healthy School Children of Navi Mumbai.

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Abstract:

PEFR (Peak expiratory flow rate) is reliable parameter to assess the severity of obstructive airway disease, as well as the effectiveness of the current therapy and need for any additional treatment. Studies have shown racial and ethnic differences in pulmonary functions and lung volumes. Hence it is needed to construct reference values for each regional population.

Method: The present study was undertaken to establish normal reference values of peak expiratory flow rates (PEFRs) among randomly selected 1020 apparently healthy school children of Navi Mumbai between 5 - 12 years of age. PEFR measurements were recorded in L/min using standard Wright's Mini Peak Flow Meter. Mean PEFR were calculated for each age group with \pm SD. PEFRs were correlated with somatic parameters like age, weight and height. Predicted regression equations were derived for each pair of dependent and independent variables for boys and girls separately. For quick reference nomogram was constructed.

Result: Across all age groups boys had more PEFR values than girls. As the age, weight and height increased the PEFR values increased. Positive correlation was seen between PEFRs and all somatic parameters. The best correlation was with regards to age ($r=0.8926$ for girls and $r=0.8697$ for boys) and height ($r=0.8722$ for girls and $r=0.8709$ for boys). The prediction equation of PEFR based on age was: $PEFR=20.6322*age - 26.5989$ (for girls), $PEFR=20.7234*age-15.0153$ (for boys), and on height was: $PEFR= 3.1852*height-252.5706$ (for girls), $PEFR= 3.1852*height- 252.5706$ (for boys).

Conclusion: The study provides values of PEFR (mean \pm 2SD) in normal children of Navi Mumbai. PEFR can be easily calculated by derived linear regression equation. Constructed nomogram is useful for this population of Navi Mumbai.

Key Words

Peak expiratory flow rate, obstructive airway disease, nomogram, predicted linear equation, age, Wright Mini flow meter.

1. INTRODUCTION

One of the major cause accounted for increased childhood morbidity and mortality is obstructive airway disease. Asthma is the most frequently treated disease during childhood. Assessment of pulmonary function test in such children is very important. The PEFR is one

among the lung function test, which not only is helpful in evaluating obstructive airway diseases but also helps in monitoring the disease progression and response to treatment. Peak expiratory flow rate (PEFR) is a person's maximum flow rate that is produced during a forceful exhalation after a full inspiration and correlates reasonably well with the predicted value for the forced expiratory volume in one second (FEV1), as measured with a peak flow [1]. The measurement of peak expiratory flow was pioneered by Martin Wright. PEFR is voluntary effort and muscular strength dependent parameter. Studies have documented that a wide range of variables like geographic (urban to rural), climatic (high to low altitudes), anthropometric (age, sex, weight and height), nutritional and socioeconomic status are associated with regional differences in lung functions [2-5]. Sustained air pollution levels prevalent in urban megacities could be another reason for regional differences. Children of different regions of the same country should have their own regional nomograms. Hence the study was undertaken to establish nomogram for PEFR in healthy Indian school children of Navi Mumbai and then to derive prediction equations for PEFR with anthropometric measurement which had a best co-efficient and use this in the said population.

2. MATERIALS AND METHODS

After the proper approval from the institutional ethical and scientific committee, school principal and consents from both parents and children, a cross-sectional observational study was conducted with randomly selected 1020 normal Indian school children between age 5-12 years. The study was conducted from February 2018 to April 2018. All children were examined clinically for any systemic illness. Children suffering from major medical illness and any acute respiratory symptoms were excluded from study. Somatic parameters like age, weight and height were recorded at the time of examination. The range of age, weight and height were defined. Age was recorded in years. Standing height was measured in cm with standard stadiometer to nearest 1mm without shoes. Weight was measured in Kgs to nearest 100 gm with minimal school uniform clothing with standard calibrated bathroom scale. PEFRs measurements were recorded using Wright's Mini Peak Flowmeter for each child. The procedure of PEFR measurement was first demonstrated to children. Each child was asked to blow into the device

after maximum inhalation. This procedure was repeated thrice. All three readings were documented and highest of the 3 noted value was taken into account. To record PEFR disposable mouth pieces were used. To minimize the error, one investigator took all the measurements. Distribution of PEFRs with SD were tabulated for different age groups separately for girls and boys. Coefficient of correlation and regression equations predicting PEFR from age, weight and height was derived for both gender separately.

3. FINDING AND ANALYSIS

Out of 1020 children, 447 were girls and 573 were boys (44 % girls and 56 % boys). Most of the children were from middle and lower socioeconomic group. The entire data was analyzed separately for girls and boys. On an average the distribution of girls and boys in each age groups were almost the same. Table 1. shows gender specific mean PEFR with SD for different ages. The mean PEFRs values increased linearly with age, weight and height. Boys had higher PEFR values as compared to girls of the same age. Although body proportion and rate of general somatic growth are strikingly different between girls and boys, their PEFR values did not display a significant difference. Other studies have also reported similar observations [6–8]. The coefficient of correlation (r) was calculated for all the variables. There was a positive correlation of dependent variable i.e.

PEFRs with all independent variables i.e. anthropometric measurements viz age, weight and height. A number of studies have assessed PEFR and correlated to somatic parameters in children. Our study showed best predictor for PEFR was age followed by height and least was weight, as against other studies which had height as the best predictor for PEFR followed by age and then weight [9-11]. The correlation of PEFR with age was $r = 0.8926$ for girls and $r = 0.8697$ for boys, followed by height was $r = 0.8722$ for girls and $r = 0.8709$ for boys. Linear regression equations for predicting PEFR dependent variable from independent variables was also calculated separately for girls and boys. Table 2. shows regression equations and r values for each variable. For all derived regression coefficients the p-value was <0.001 . In present study mean PEFR values when compared with other Indian (north and south) studies had lower values [12 -14]. This can be explained on basis of diversities of ethnic, linguistic, regional, economic, religious, class, caste, changing life style crosscut Indian society with immense urban-rural differences and most important cooperative attitude of child or child must have not performance the best in the test. Age and height standardized nomogram has been constructed from the linear regression equation using PEFR as dependent variable and age and height as independent variable both gender separately [Fig 1- 4]

Table 1. Distribution of age with the mean and SD of PEFR separately for girls and boys.

Age (years)	No. of Girls	PEFR Girls (n=447)	No. of Boys	PEFR Boys (n=573)
5	51	90.20 ± 21.75	67	100.45 ± 22.19
6	49	102.67 ± 22.76	64	116.02 ± 22.04
7	52	133.75 ± 33.27	68	138.94 ± 35.39
8	53	149.53 ± 33.77	62	172.48 ± 43.53
9	48	176.67 ± 36.98	99	199.37 ± 43.31
10	50	190.14 ± 31.72	74	200.02 ± 29.25
11	66	206.34 ± 29.25	66	223.79 ± 35.84
12	71	235.55 ± 33.55	65	242.64 ± 37.34
13	7	250.00 ± 41.83	8	250.17 ± 36.88

Table 2: Regression equations and coefficient of correlation analysis of variables to PEFR

	Regression Equation	Pearson Product
Age vs PEFR Female	$y = 20.6322x - 26.5989$	0.8926
Age vs PEFR Male	$y = 20.7234x - 15.0153$	0.8697
Weight vs PEFR Female	$y = 5.2785x + 20.843$	0.8618
Weight vs PEFR Male	$y = 4.8688x + 41.3061$	0.8546
Height vs PEFR Female	$y = 3.1852x - 252.5706$	0.8722
Height vs PEFR Male	$y = 3.1852x - 252.5706$	0.8709

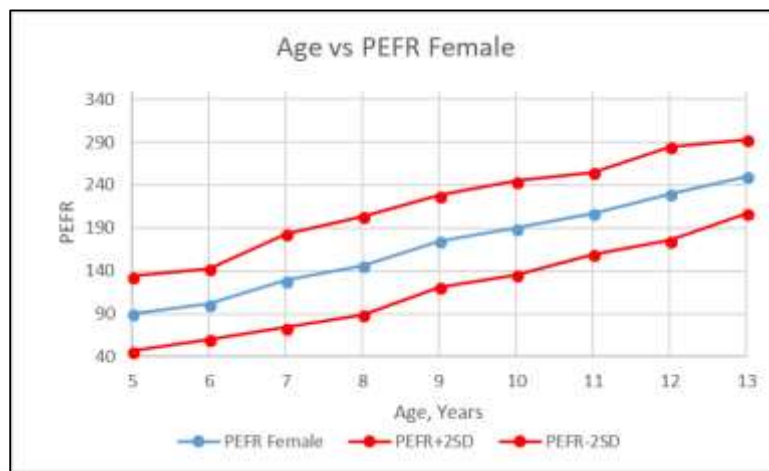


Figure 1. Nomogram of Age vs PEFR in girls

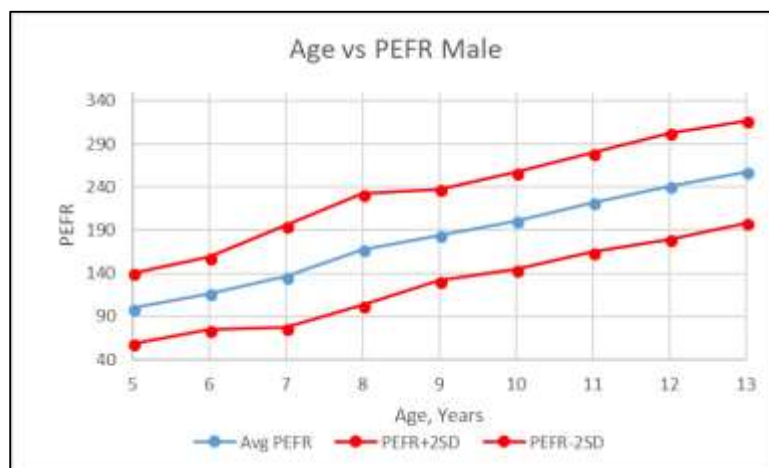


Figure 2. Nomogram of Age vs PEFR in boys

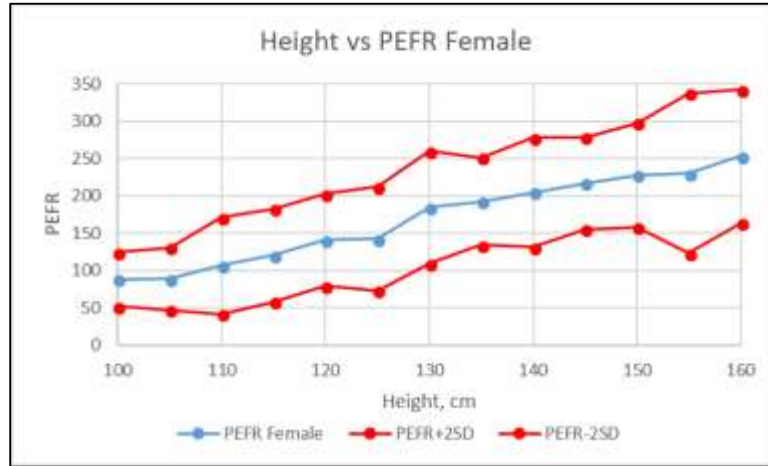


Figure 3. Nomogram of Height vs PEFR in girls

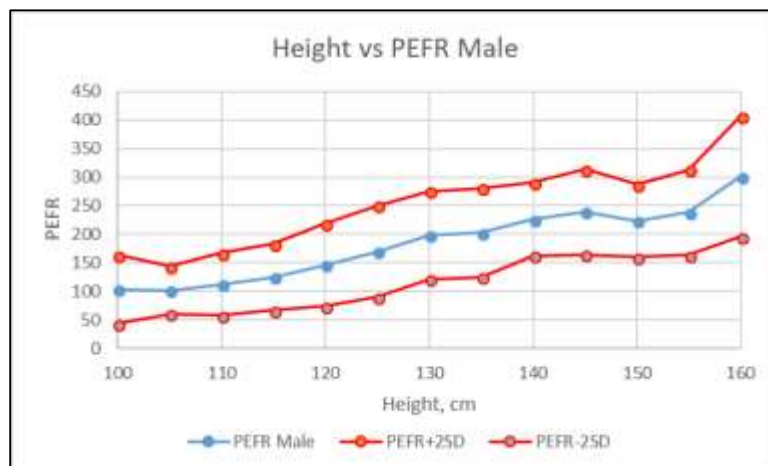


Figure 4. Nomogram of Height vs PEFR in boys

4. RECOMMENDATION

- Parent education is essential to recognize early asthmatic attacks by regularly doing PEFR and documenting variations day and night.
- Within the country there should be region-wise separate PEFR reference values for children.
- PEFR measurement procedure is easy, safe, simple and reliable with Wright Mini peak flowmeter.

- Wright Mini Peak flowmeter is gaining acceptance world-wide for its use at home.
- When accurate age of child is not known, correlate the PEFR value with the height.

5. CONCLUSION

- Due to large sample size, our present study represents the population more closely.
- PEFR norms developed by this study can be considered a standard local reference range for child population of Navi Mumbai and can be used further for assessing the progress of obstructive airway disease mainly bronchial asthma

- PEFR provides quantitative measurement of improvement to response to treatment and ultimately reaching goal that is improving the quality of life.
- There is a compelling need to conduct more similar studies among growing children in India, as the mosaic of Indian population, spreading over such a varying geography is quite complex.

Funding—nil

Conflict of interest—nil

Anjali Otiv was involved in data collection, interpretation, analysis and drafting the article. Mitali Nayak conceived the study and revised the manuscript for important intellectual content.

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