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Original Research Article

Peak Expiratory Flow Rates in Children of Western Maharashtra 10-16 Years of Age

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ABSTRACT

Background: A lot of age-specific variations in Peak Expiratory Flow Rate (PEFR) are expected in paediatrics age group compared to adults.Although, many studies have evaluated the PEFR values in the children from various regions in India, but their results cannot be extrapolated to W. Maharashtra children, since not only the environment, but also the customs, traditions, and life-style are altogether different in this part of the country.
Method: 642 apparently healthy school children (461 Male, 181 Female) from age group years were included in the study. PEFR was measured in L/min with a standard Wright Peak Flow Meter.
Result: Positive correlation was seen between age, height, weight and PEFR. The regression equations for PEFR were determined for boys and girls separately. The prediction equation for PEFR based on Weight was PEFR=187.1+ weight×3.84 (for boys) PEFR=221 + weight×2.30 (for girls). Predicted formulas obtained by regression equation for Age were: PEFR=20.7 + Age×22.94 (for boys), PEFR=99 + Age×15.7 (for girls). Predicted formulas obtained by regression equation for height were: PEFR= Height×3.64 -233.3 (for boys) PEFR= Height×2.91 - 103 (for girls). In both male and female children, PEFR significantly increases ($p < 0.05$) with height, weight, age.
Conclusion: PEFR is a reliable measurement, which can be used in areas of Western Maharashtra for assessment of airway obstruction. Prediction formula is derived for use in this population.

Keywords: PEFR, Western Maharashtra, Children, Indian, Factors, Age, Height

INTRODUCTION

Respiratory diseases are the most common cause of death in both developed and developing countries. Bronchial asthma during childhood is common chronic airway disease. There is enough evidence to suggest that the prevalence of this disease is increasing, consequently the morbidity and mortality of bronchial asthma also increasing

Pulmonary function tests of various types are utilized clinically and epidemiologically to measure functional status in order to assess the disease. [1] Though they do not provide a specific diagnosis, they help us to understand the physiology, course and progress of the respiratory diseases, assess the severity and help in the management of number of respiratory diseases. [2] Pulmonary function testing in a child differs from that in adult, largely because of the volume change that occurs from birth through the period of growth to the adulthood. These differences influence technique, methodology and interpretation. [3,4] However, most of them are cumbersome, expensive and difficult to obtain reproducible results in children.

Asthma is the most common chronic inflammatory disease in children and is a

major global health problem which exerts a substantial burden on the family, health care services and on the society as a whole. Prevalence of asthma in children is increasing day by day globally supported by 3 different studies in different countries. Bronchial asthma is a common respiratory disease of childhood which is associated with fluctuation in airway calibre and one of earliest sign of impending attack is fall in PEFR

PEFR measurement can reveal the diurnal variability of airway of patient has been suffering from reactive airway disease but not in normal children that gives the early clue to have the diagnosis and management. Fall of peak expiratory flow rate in a child with asthma is impending sign of acute asthma. The response to treatment can be monitored by using serial PEFR measurement. Peak expiratory flow rate measurement gives the idea of status of airway caliber of respiratory system and regulatory function of respiration which sometimes affected by certain progressive neurological disease. As no physician can understood the status of progress and treatment of diabetes mellitus without doing simple blood sugar test, no clinician could manage a patient with potential renal failure without an estimation of blood urea level, PEFR can be used as pulmonary function test in the same way. The occurrence of diurnal variation of symptoms and airway resistance in asthmatic children are well perceived, thereby early intervention of treatment pattern and efficacy of drug can be documented by measurement of peak flow rate. PEFR can be used not only to see the airway obstruction, can be used to classify the severity of diseases of airway obstruction and its management and as a guide line of admission and discharge of asthma patients

In 2007, an expert panel of the National Asthma Education and prevention program recommended periodic assessment of pulmonary function by spirometry or peak flow monitoring

It is a well-known fact that lung function parameters vary considerably between different regional and ethnic groups, residing within the same country. 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 PEFR values in the children from various regions in India, but their results cannot be extrapolated to Maharashtra children, since not only the environment, but also the customs, traditions, and life-style are altogether different in this part of the country. Thus, we felt the need to carry out a study to obtain newer reference values of PEFR in Maharashtra school children aged 10-16 years.

MATERIALS AND METHODS

Six hundred and forty two (642) apparently normal school children (461 male and 181 female) from age of 10–16 yrs were included in the study. A preliminary clinical evaluation was done with the help of history, general physical examination and systemic examination in all the children. Children with major medical illness and those having acute respiratory infections within 7 days of the study were excluded. The children with asthma and tuberculosis were excluded. The exclusion criteria for recurrent cough or chest infection; a family history of asthma or any person taking bronchodilator metered dose inhaler (MDI) in the family; rhonchi or wheeze on auscultation. All of the children were examined thoroughly to exclude any underlying heart, lung or systemic disease. The age of the subjects were recorded in year. Standing heights (stature) were measured in Cm with a standard stadiometer. Weights were measured in Kg. The height nearest to 0.1 Cm and weight nearest to 0.1 Kg with minimal clothing were measured using the height and weight scale. PEFR was measured in L/min with a standard Wright Peak Flow Meter (60–800 L/min). At rest and in a standing position,

each child blew three times, without nose clip, into a standard Mini-Wright peak flow meter Instructions and method of carrying out the test was demonstrated to the subjects. Each subject made 3 PEFR manoeuvres and the highest value was recorded, since this parameter requires maximum efforts. Results were expressed as Mean PEFR±SD. For statistical analysis Pearson's correlation coefficient test was used. Linear regression equations for PEFR in relation to Age, height, weight were determined for boys and girls separately. A *p*-value of <0.05 was considered statistically significant

RESULTS

A total of 642 healthy children of age group 10–16 years comprising 461 males and 181 females were used for determination of PEFR. 70.8% children were male and 29.2% were females. Mean values of weight, height showed a gradual increase with the increment of age of children among both sexes, but anthropometric parameters were better among male children (Table-1). Table-2 shows variation of PEFR in both male and female subjects according to their weight. Observations show that in both the genders PEFR were higher in males. In both the genders weight and PEFR shows significant correlations $p<0.001$. Predicted formulas obtained by regression equation for weight were following:

PEFR = 187.1 + weight ×3.84 (Boys)
PEFR = 221 + weight ×2.30 (Girls)

Table No. 1: Mean Weight and Height in male and female subjects according to age

Age (Year)	Male (n=461)			Female (n=181)		
	No.	Weight (Kg)	Height (Cm)	No.	Weight (Kg)	Height (Cm)
10	3	27.3±4.16	136.33±7.77	-	-	-
11	14	28.9±4.79	138.68±7.11	6	32.8±7.16	138.1±4.82
12	84	31.3±6.78	140.29±7.10	23	29.9±4.38	141.1±7.64
13	172	34.38±6.19	146.39±7.74	87	36.7±5.73	148.3±5.102
14	129	39.09±8.36	150.39±14.41	53	40.15±6.3	151.7±6.84
15	54	40.58±6.28	155.82±6.86	12	41.7±8.06	151.25±5.02
16	5	45.50±9.21	160.9±4.68	-	-	-

Table No. 2: Mean values of PEFR in subjects according to weight

Weight (Kg)	Male (n=461) PEFR (L/min)	Female (n=181) PEFR (L/min)
20-25	272±30.2	263±16.6
26-30	290±28.4	277±31.1
31-35	319±30.8	298±28.9
36-40	340±30.8	315±33.7
41-45	356±31	317±29.9
46-50	375±37.2	330±19
51-55	385±34	334±18.7

Table No. 3: Mean values of PEFR in subjects according to their age

Age (yrs)	Male (n=461)		Female (n=181)	
	No.	PEFR (L/min)	No.	PEFR (L/min)
10	3	260.7±17.79	-	
11	14	2283.14±26.38	6	248.3±9.04
12	84	290.74±34.06	23	276.35±28.32
13	172	319.69±37.62	87	307.8±29.6
14	129	344.15±38.76	53	318.3±29.83
15	54	361.85±28.69	12	321.2±34.05
16	5	385±30.21	-	

Table-3 shows variation of PEFR in Male and Female children according to their age. In all age groups Males shows higher mean PEFR then Females. In both genders age and PEFR showed significant correlation with each other, $p<0.001$. Predicted formulas obtained by regression equation for Age were following:

PEFR = 20.7+Age×22.9 (Boys)
PEFR = 99 +Age×15.7 (Girls)

Table No. 4: Mean values of PEFR in subjects according to their height

Height (CM)	Male (n=461) PEFR (L/min)	Female (n=181) PEFR (L/min)
130-135	261±25.1	241±26.4
136-140	282±16.2	265±14.9
141-145	307±19.6	281±14.9
146-150	320±14.6	298±13.6
151-155	345±13.4	333±19.17
156-160	368±19.26	347±10.7
161-165	395±16.3	356±4.7
166-170	425±20.49	------

Table-4 shows variation of PEFR with height in Male and Female children. For the similar height males shows higher PEFR

then Females. PEFR and Height shows significant correlation in both the genders P<0.001 Predicted formulas obtained by regression equation for height were following:

PEFR = 2.97 × Height – 118.9 (Boys)
PEFR = 3.64 × Height – 233.3 (Girls)

Table No. 5 Comparative mean values of PEFR (L/min) observed by different workers

Age	Sharma *et al* 1965 [5]		Singh *et al* 1978 [6]		Deshpandey *et al* 1983 [7]		Rahman *et al* 1990 [8]	
	Male	Female	Male	Female	Male	Female	Male	Female
6	149±31.22	121.44±19.27	121.6±31.6	113.3±37.1	--	--	--	--
7	182.12±53.84	154.53±33.38	147.4±39.6	134.2±34.9	--	--	--	--
8	200.83±49.42	178.69±48.72	184.1±34.6	148.1±36.9	147.4±14.46	167.6±15.49	--	--
9	230.29±49.46	206.36±53.91	197.4±42.8	181.9±48.9	186.4±32.19	178.8±37.65	--	--
10	236.47±59.16	214.50±63.71	227.5±45.7	214±36.5	217.6±17.27	201.2±23.29	--	--
11	266.6±46.63	238.45±58.20	231.4±47.8	230±44.6	--	--	--	--
12	273.59±51.15	272.93±57.68	267.9±38.9	248.8±42.0	--	--	312±7.3	354±3.9
13	300.35±73.08	296.81±57.40	270±43.8	248.8±42.0	--	--	349±7.3	371±3.7
14	328.07±70.35	312.67±54.67	318.8±68.2	320.8±60.2	--	--	372±9.5	385±4.7

Table No. 6: Correlation coefficients worked out by various workers between PEFR and anthropometric Variables

Study	Age		Height		Weight	
	Male	Female	Male	Female	Male	Female
Present Study	0.56	0.43	0.74	0.84	0.68	0.50
Sharma *et al* 1965[5]	--	0.73	--	0.75	--	0.65
Singh *et al* 1978[6]	0.87	0.89	0.90	0.89	0.88	0.87
Deshpandey *et al* 1983[7]	--	--	0.47	0.63	0.38	0.68
Rahman *et al* 1990[8]	0.76	0.50	0.76	0.75	0.75	0.69

DISCUSSION

PEFR is the maximal expiratory flow that can be achieved and sustained for a period of 0.01 second. PEFR is very useful in monitoring the long term management of asthma and determining its severity. PEFR is expressed in L/min. PEFR is a simple and reliable way of monitoring the severity of bronchial asthma and assessing the response to treatment. It is a measurement which is dependent upon several variables including airway resistance maximal voluntary muscular effort and the possible compressive effect of the manoeuvre on thoracic airways. This study aimed to establish normal values of PEFR for healthy children of Western Maharashtra so that local reference standards are available when this measurement is used for the assessment of asthmatic children. Our data indicate that PEFR values for same age is higher in male children in comparison to their counterparts, (Table-3). Most of the other studies have recorded similar trends. However, Singh and Peri, [5] and Deshpandey *et al* [6] in their studies an normal South Indian children did not show any sex variability in PEFR on the contrary Rahman *et al* [7] reported that in the same age group girls had higher PEFR than the boys. Comparative observations by different key workers is summarised in the (Table-5). Mean values of PEFR in our study are in accordance with the studies done by above five workers mentioned in (Table-5). In contrast to our results Primhak *et al* [8] from Greece have reported higher PEFR values in their children. This display is explainable on the basis of body built, height and ethnicity. This is well known that European children are taller and heavier than the Indian children. Correlation coefficients of PEFR with age, height, weight were computed from our data and results were compared in summarised from in the (Table-6). Although our correlation coefficient-values are lower in comparison to all other workers yet the correlation between PEFR and age, height, weight were positive and statistically significant (p<0.01 for all variables) (Table-2–5). Another important fact is that correlation coefficients were better for male children in present study as well as all other studies except in the study done by Deshpandey *et al*. [6] Overall, the study showed that in both male and female children, PEFR significantly

(p<0.05) increases with height, weight, age. Regression equation has been derived for age, height, and weight with PEFR. Results shows that PEFR values for corresponding age, height, and weight were higher among male subjects than female. Regression lines derived for age and height maintain same difference through all the ages. In present study, positive correlation was found between PEFR and anthropometric variables. The norms established in the present study can very well serve the purpose of physiologists as well as clinician of this region. Physicians usually refer to common international references for obtaining different normal values, but it has been shown that PEFR values vary with racial, socioeconomic and genetic features, and with lifestyle. Therefore, it would be more appropriate for each country to have its own region reference values

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