Original Article ISSN (O):2395-2822; ISSN (P):2395-2814

A Study of Peak Expiratory Flow Rate (PEFR) in 6-12 years Age Group in Relation to Height in Eastern India.

Sandeep Sen[1], Anjan Kumar Das[2], Kumar Abhishek[3]

[1]Associate Professor, Department of Pediatrics, Dr B.C. Roy PGIPS, Kolkata.
[2]Assistant Professor, Department of Pediatrics, Dr B.C. Roy PGIPS, Kolkata.
[3]Postgraduate student, Department of Pediatrics, Dr B.C. Roy PGIPS, Kolkata.

Received: October 2019
Accepted: October 2019

ABSTRACT

Background: Bronchial Asthma is a common cause of mortality and morbidity in the developing world like India. Objective: The purpose of the present study was to establish a nomogram for PEFR in 6-12 yrs age group in relation to height in Eastern India, a first of its kind study from Eastern India. Setting: 1003 randomly selected healthy school children in Kolkata. Study Design: Prospective cross sectional study. **Methods:** Mini Wright peak flow meter was used to measure PEFR in resting condition and standing position. The best value of three attempts was recorded and compared to height, weight, sex and age separately. Multiple regression analysis was used to determine the influence of various variables. **Results:** Height ranged from 95 cm to155 cm and PEFR ranged from 115 L/min to 335 L/min irrespective of sex. Mean PEFR was 241.5 L/min in all sexes whereas the median, 25th percentile and 75th percentile values were 244.1 L/min, 186 L/min and 290 L/min respectively. PEFR values increased in a linear pattern with increase in height in both sexes. Using multiple regression analysis we can estimate the PEFR values with height alone in both sexes with more than 95% accuracy. **Conclusion:** PEFR values depend on height, weight, age and sex, the former being the most important parameter.

Keywords: Bronchial Asthma, Peak Expiratory Flow Rate.

INTRODUCTION

Asthma is the most common lung disease affecting persons of all ages and is a major health problem [1]. Boys (15% vs 13% girls) are more affected and 80% of all asthmatics report disease onset prior to 6 yr of age [2]. It has been recommended that pulmonary function tests i.e. PEFR and spirometry should be a part of the diagnostic evaluation and treatment of asthma. Peak flow meters are small, portable, convenient and inexpensive devices that can be easily used in outpatient departments to diagnose asthma, assess severity and evaluate response to therapy. Spirometry provides additional information about the degree of small airway obstruction and help in differentiating obstructive from restrictive disorders. Ethnic differences including genetic and environmental factors have been shown to account for differences in PEFR [3,4]. So each ethnic group or region should ideally have its own reference values for better evaluation and comparison. No such reference values are present for Eastern India and this is an attempt to create PEFR reference values in relation to height for children in the 6-12 years age group for this region.

Name & Address of Corresponding Author
Dr Anjan Kumar Das.
Assistant Professor,
Department of Pediatrics,
Dr B.C. Roy PGIPS,
Kolkata.

MATERIALS AND METHODS

Using statistical methods the sample size was calculated to be 1003 with the power of the study being 86% with a confidence interval of 95%. This study was carried out in 1003 school children of age group 6 to 12 years in Kolkata for a a period of twelve months from May 2018- May 2019. The subjects of the study were chosen at random irrespective of the socio-economic status, sex and religion so that it can reflect an overall picture of the PEFR status of children in this city. Children fulfilling the criteria as suggested by Taussig et al,[5] were included in the study. These are:

i) absence of any chronic lung disease
ii) no history of acute respiratory tract infection in the preceding 3 weeks,
iii) no major respiratory tract disease or thoracic surgery in the past,
iv) no systemic disease influencing the respiratory system, and
v) non-smoker.

A detailed examination, including anthropometric measurements (weight, height, chest circumference) was carried out and any child weighing less than 80% of 50th centile of NCHS standards or with a height of less than 2SD of NCHS standards was not included in the study. A Mini Wright flow meter (Clement Clarke International, U.K.) was used to measure the PEFR in the standing position. After demonstration, all children were first tested using low range paediatric peak flow meter (range 0-350 L/min) and if the PEFR exceeded the upper limit they were then tested on the standard (adult) flow meter (range 60-800 L/min). The best of three values were compared against standard reference values. Those students having lower peak value were subjected to inhalation therapy using a spacer of 250 ml volume and salbutamol inhaler. Those with improvement of 15% or more were considered asthmatic and excluded from the study. Various statistical analyses of data by Graph Pad software was done to create reference values of PEFR in relation to height, age and sex (male and female) separately, p values were obtained to predict significance and multiple regression analysis was used to predict PEFR value from the height alone and also from height, age, sex simultaneously.

RESULTS

1003 children were enrolled in this study, 468 (46.8%) were boys and 535 (53,5%) were girls. The result of mean PEFR values in relation was expressed in the [Table 1] and graph [Figure 1]. It is obvious that the mean PEFR values correlated well with height. PEFR values increase in more or less in linear fashion with respect to height in cm in different age groups. It was seen that the mean PEFR was 241.5 L/min in all sexes whereas the median, 25th percentile and 75th percentile values were 244.1 L/min, 186 L/min and 290 L/min respectively. Here Standard Deviation (SD) is 59.7, Standard Error (SE) is 7.7, whereas the lower and upper 95% Confidence Intervals (Cl) were 226.1 and 256.8 respectively. For male children PEFR ranged from 150 L/min to 350 L/min while the mean was 262.7 L/min, the median was 262 L/min and SD was 67.67. For female children PEFR ranged from 110 L/min to 310 L/min, while the mean was 224.17 L/min, the median was 228.6 L/min and SD was 58.63. For the better understanding and comparison of the PEFR values in different age groups, the total number of children has been divided into three age groups- i.e. 6-8 yrs, 9-10 yrs and 11-12 yrs. It was evident that the PEFR values were increased with age and male children of all age groups had higher PEFR values than females [Table 2]. Multiple regression analysis was used to model the PEFR values from height, weight and age [Table 3]. The model was found to be strong with this model explaining 95% of the variation of data.

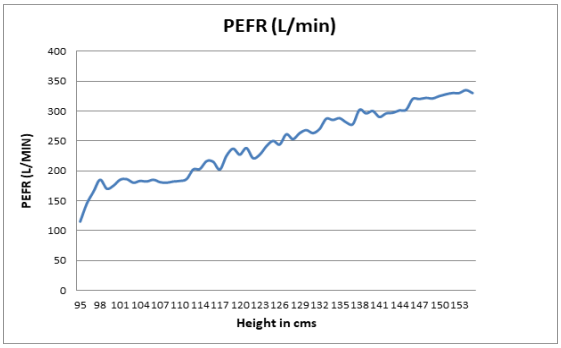

Figure 1: Graphic Representation of PEFR values (L/min) in relation to height

Table 1: Result of mean PEFR in relation to height

Height In cm	N	PEFR L/min	Height In cm	N	PEFR L/min	Height In cm	N	PEFR L/min	Height In cm	N	PEFR L/min
95	33	115	110	24	183	126	17	244	141	8	290
96	27	145	112	19	186	127	15	261	142	10	296
97	29	165	113	25	202	128	13	253	143	12	297
98	31	185	114	23	203	129	12	263	144	14	301
99	22	170	115	21	216	130	14	268	145	09	302
100	15	175	116	19	215	131	16	263	146	08	320
101	27	185	117	17	202	132	18	270	147	09	320
102	19	186	118	15	225	133	18	287	148	15	322
103	28	180	119	14	237	134	12	285	149	13	321
104	27	183	120	16	227	135	18	288	150	11	325
105	23	182	121	18	238	136	11	281	151	09	328
106	17	185	122	20	221	137	13	278	152	07	330
107	19	181	123	11	227	138	09	302	153	05	330
108	18	180	124	21	241	139	07	296	154	04	335
109	22	182	125	19	250	140	05	300	155	06	330

Table 2: Distribution of mean PEFR in Different Age groups of male and female

Age in yrs	Male			Female			p value
	N	Mean (L/min)	SD (L/min)	N	Mean (L/min)	SD (L/min)	
6-8	243	235.7	56.13	325	205.42	49.31	<0.0001
9-10	157	302.07	42.96	107	250.28	48.18	<0.0001
11-12	68	318.09	50.62	103	268.93	54.88	<0.0001

Table 3: Multiple regression analysis of mean PEFR

a) PEFR (male) = 3.4654 HEIGHT (cm)-170.3831 PEFR (female) = 2.8390 X HEIGHT (cm)-130.7042
b) PEFR (male) = 2.2268 X HEIGHT (cm) +11.0164 X AGE (yrs) + 0.7979 X WT (kg) PEFR (female) = 1.8294 X HEIGHT (cm) +7.1081 X AGE (yrs) - 0.8073 X WT (kg)

DISCUSSION

According to our study height ranged from 95 to 155 cm, PEFR ranged from 115 L/min to 335 L/min with mean PEFR value of 241.5 L/min and median was 244.1 L/min. PEFR values in both male and female children increase with height and male children have higher PEFR values than female children. Using multiple regression analysis we can calculate the expected PEFR only from height alone or from height, weight and age simultaneously. When using the former, the expected PEFR is calculated with >95% accuracy. When we compare our study with other Indian as well as Western studies, we find the maximum height obtained in their studies to be more than our maximum of 155 cm. To compare the PEFR values of the children with height of 160 cm with other studies, we took the help of multiple regression analysis which showed the expected PEFR in our study at 160 cm height to be 384 L/min and 324 L/min for male and female respectively.

All the studies including ours showed that the PEFR had most positive correlation with height.[6-9,11] Likewise PEFR was more in boys as compared to girls of the same age group. This can be attributed to the fact that the boys had more height and thus,[7-9] more lung volume resulting in more PEFR. Also all studies including ours showed an increase in PEFR with age.[6-9,11] When we compare our study with other Indian studies, the results are fairly comparable with the studies of Swaminathan et al,[10] Paramesh.[6] Paramesh,[6] failed to show significant differences between the mean PEFR values in boys and girls. Swaminathan et al,[10] also observed that the PEFR values were gradually increased with age which is comparable to our study. Our children showed higher PEFR values in all age groups as compared to Swaminathan et al,[10] the probable reason being the ethnic variation between the two study groups. For comparison with some recent studies only those studies were included which had comparable sample size to our study. Compared to some recent studies the PEFR mean value studied in various age groups in studies from different regions varied for the age groups and western and southern regions children had comparatively lower PEFR values than eastern Indian children.[7-9,11]

ATTRIBUTE	**Durairaj P et al[7] (Chennai Study)**		**Anjali Otiv[11] (Mumbai Study)**		**Jomon Mathew[9] (Ernakulam Study)**		**Sandip Sen et al (Current study)**	
N	**1470**		**1020**		**954**		**1003**	
Mean PEFR of the study							**241.5 + 59.7** **Boys= 262.7 + 67.67** **Girls= 224.17+ 58.63**	
Age grp.	MEAN PEFR (L/min)							
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
6yrs	176.5± 5.2	65.9± 4.7	116.02 + 22.04	102.67 + 22.76			253.7+ 56.13	205.42+ 49.31
7yrs	202.2± 4.4	185.5± 3.4	138.94 + 35.39	133.75 + 33.27				
8 yrs	244.6± 5.6	185.5± 3.4	172.48 + 43.53	149.53 + 33.77	167.94+ 39.60	145.18+ 38.85		
9 yrs	251.6± 8.1	226± 6.8	199.37 + 43.31	176.67 + 36.98	188.54+ 37.65	170.11+ 34.62	302.07+42.96	250.28 +48.18
10 yrs	272.9± 4.5	262.9± 6.4	200.02 + 29.25	190.14 + 31.72	210.10+ 38.93	181.56+ 36.28		
11 yrs	307.6± 8.4	281.7± 5.4	223.79 + 35.84	206.34 + 29.25	220.68+ 45.90	201.56+ 44.56	318.09+ 50.62	268.93+ 54.88
12 yrs	324.8± 6.8	305.7± 9.1	242.64 + 37.34	235.55 + 33.55	251.21+ 49.36	217.32+ 53.38		

Srivastava S et al,[8] (Lucknow) in his study in 2017 with a sample size of 1006 school children has shown a mean PEFR of 272.02 ± 92.22 L/min in case of boys and 213.57 ± 64.46 L/min in case of girls.

We have omitted studies older than 5 years and with sample size less than 950 to improve the comparison and accuracy of the study.[12-15]

Multiple regression analysis was used in our study to predict the PEFR values. Our study found that PEFR equation can be used to predict the PEFR value fairly accurately with height being the best predictor variable. Paramesh,[6] had also observed that height is the best predictor of assessing PEFR. Our model showed strong degree of accuracy (95% level). The model for PEFR differs between male and female. This model needs to be verified among different ethnic groups in our country.

CONCLUSION

The regular measurement of PEFR in asthmatic children is of great value to monitor their clinical

status, management and follow up. The purpose of this study was to create references values of PEFR for children of Eastern India living at sea level in a tropical climate. We sincerely hope that more such studies will be done in future on a larger scale to generate more accurate reference values and that similar data would also be available from other parts of the country.

REFERENCES

1. Paramesh H, Bronchial Asthma. In Parthasarathy A, Menon PSN, Nair MKC, Gupta Piyush, editors, IAP textbook of Pediatrics ; 5th edition, New Delhi: Jaypee;2013, p505
2. Liu AH, ,Spahn JD, Sicherer SH, Childhood Asthma In Kliegman RM,, St Geme III JW, Blum NJ, ShahSS, TaskerRC, Wilson KM, editors, Nelson Textbook of Pediatrics Vol 1; 21st Edition Philadelphia: Elsevier;2020, p1095.
3. Pool JB, Greenough A. Ethnic variation in respiratory function in children, Resp Medicine 1989,83:123-125,
4. Done[[y PM, Young TS, Peat J K, Woolcock AJ. What factors explain racial differences in Lung volumes, EurResp Journal 1991,4:829-838.
5. Taussig LM, Chernick• V, Wood R et al Standardization of Lung Function Testing in children: Proceedings and recommendations of the GAP conference committee, J Pediatrics 1980:97:668-676.
6. Paramesh H., Normal PEFR In urban and rural children, Indian Journal Pediatrics, Vol 70- May, 2003 Pg 375-377.
7. Durairaj P et al. Measurement of peak expiratory flow rate values in healthy school going children between 6 and 12 years attending urban schools in Chennai Int J ContempPediatr. 2017 Nov;4(6):2002-2007. DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20174679.
8. Srivastava S et al. Correlates of peak expiratory flow rate and deriving the prediction equation in school going children of Lucknow ,Int J Community Med Public Health. 2017 Oct;4(10):3550-3553. DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20174096.
9. John JM. Pediatric peak expiratory flow rate nomograms for Ernakulam district. Indian J Allergy Asthma Immunol 2017;31:83-6
10. Swaminathan S, Venkatesan P, Mukunthan P, PEFR in South Indian children, Indian Pediatrics-Vol 30- Feb 1993 Pg207-210.
11. Otiv A, Nayak M. Pediatric Peak Expiratory Flow Rates Nomogram for Healthy School Children of Navi Mumbai. ,Intl Journal Of Research,2018;05(15):6.
12. Malik SK et al PEFR of healthy school boys from Punjab, Indian Pediatrics :Vol 18, Aug 1981: p517-519.
13. Jain SK, Kumar R, Sharma DA; Peak expiratory flow rate in relation to anthropometric measurements in normal Indian subjects. East Afr Med J, 1982;59(9):593-598
14. Chowgule RV, Shetye VM and Parmar JR; Lung function tests in normal indian children. Indian Pediatr, 1995; 32(2): 185-191
15. Kashyap S, Puri DS, Bansal SK, Jain A, Arya A, Chowdhary BR. Peak expiratory flow R, Peak expiratory flow rate of school going urban children aged 5-14 years from Ajmer district. Indian Pediatr. 2002;39:75-8.

How to cite this article: Sen S, Das AK, Abhishek K. A Study of Peak Expiratory Flow Rate (PEFR) in 6-12 years Age Group in Relation to Height in Eastern India.. Ann. Int. Med. Den. Res. 2019; 5(6):PE06-PE09.

Source of Support: Nil, **Conflict of Interest:** None declared