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Original Research Article

Peak expiratory flow rate and its correlation with height among 6 to 14 years children: a cross sectional study

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ABSTRACT

Background: The objective of this research was to study the peak expiratory flow rate (PEFR) values and its correlation with height in children aged between 6 to 14 years and height.
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, height and PEFR values were recorded. PEFR was considered as primary outcome variable. SPSS version 20 was used for data analysis.
Results: Among 1205 study participants, height showed a steady relationship with PEFR. As height increases PEFR increases progressively in both boys and girls. (R^2=0.691). The linear regression model for PEFR with height of all age shows, one centimeter increase in height there was 5.1% increase in PEFR with a constant (-458.0) and a 95% confidence interval 4.9 to 5.3, a lesser R^2=69.1% which was found to be statistically significant.
Conclusions: The PEFR values derived and its height correlation in this study can be used as reference for children in and around Chennai district.

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

INTRODUCTION

In recent times, the measurement of PEFR has become a useful tool. From a diagnostic viewpoint, it provides a better understanding of the changes in the lungs. The European respiratory society defines PEFR thus: "the maximal flow which is achieved during the expiration which is delivered with maximal force, starting from level of maximal lung inflation, following the maximal inspiration expressed in litres/min".[1,2]

Peak expiratory flow rate (PEFR) primarily reflects large airway flow and depends on voluntary effort and muscular strength of subject.[3] The peak flow meter, a useful instrument to measure Peak expiratory flow rate (PEFR), can be used in healthy children and adults. It is easy to learn, simple to perform, and is reproducible. The main factors affecting PEFR are: age, sex, height, and weight.[4]

Studies relating to PEFR and anthropometry among growing children are necessary in India as the mosaic of Indian population spreading over such a differing geography is varied and complex. A researcher studied PEFR values in healthy North Indian School children, which were similar to the findings from the western countries.[5] A study found that PEFR in South Indian school children was lower than that observed in Western and North Indian children.[6] The importance of having regional reference values is emphasized. Hence the purpose of this study is to estimate PEFR in normal healthy school going children aged 6 to 14 years in and around Chennai. The aim of this study was to record the PEFR values among children aged 6 to 14 years and to correlate it with their heights.

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 is 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

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. Table 2 presents the descriptive statistics of height for different age and sex. It also shows that mean height for boys increases with their age with small difference compared to girls.

From Table 3, we predicted the PEFR for boys with height as the independent parameter using linear regression method. For age 6 years, one centimeter increase in height there was 2.6% increase in PEFR with a constant (-166.1) and a 95% confidence interval 1.3 to 3.8, a lesser R^2 =28.2% which was found to be statistically significant. For age 11 years, one centimeter increase in height there was 1.7% increase in PEFR with a constant (-30.3) and a 95% confidence interval 1.0 to 2.5, a lesser R^2=14.9% and was statistically significant. For age 12 years, one centimeter increase in height there was 1.9% increase in PEFR with a constant (-50.5) and a 95% confidence interval 1.0 to 2.8, a lesser R^2 =14.1% and was statistically significant.

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

Sex	Age (in years)	N	Mean PEFR	Std. dev.	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 for height (cm).

Sex	Age (in years)	N	Mean PEFR	Std. dev.	Minimum	Maximum
Boys	6	46	109.28	5.94	96.00	125.00
	7	48	115.67	5.95	102.00	129.00
	8	50	120.90	6.73	107.00	134.00
	9	32	125.00	6.23	110.00	139.00
	10	57	132.18	7.11	112.00	148.00
	11	128	134.13	6.75	118.00	152.00
	12	117	139.47	7.11	123.00	160.00
	13	70	146.59	7.20	131.00	173.00
	14	70	156.13	9.20	134.00	172.00
Girls	6	44	106.75	6.55	96.00	121.00
	7	42	115.19	5.42	107.00	132.00
	8	55	119.98	5.62	106.00	130.00
	9	59	124.03	7.82	106.00	150.00
	10	69	128.13	6.42	116.00	144.00
	11	94	134.09	7.00	120.00	148.00
	12	84	139.17	7.34	123.00	157.00
	13	70	146.00	4.08	136.00	159.00
	14	70	150.97	4.75	134.00	161.00

Table 3: Regression analysis to predict PEFR based on height in cm for boys.

Age (in years)	Sex	Constant	Beta	95% CI for beta		P value	R	R^2	Adj R^2
				Lower	Upper				
6	Boys	-166.13	2.616	1.349	3.884	<0.001*	0.531	0.282	0.266
7	Boys	-201.91	2.938	1.654	4.222	<0.001*	0.562	0.316	0.301
8	Boys	68.483	0.764	-0.621	2.148	0.273	0.158	0.025	0.005
9	Boys	-53.947	2.027	0.374	3.679	0.118	0.416	0.173	0.145
10	Boys	-235.45	3.353	1.936	4.77	<0.001*	0.539	0.290	0.277
11	Boys	-30.368	1.796	1.038	2.554	<0.001*	0.386	0.149	0.142
12	Boys	-50.546	1.962	1.066	2.857	<0.001*	0.375	0.141	0.133
13	Boys	-10.538	2.508	1.43	3.586	<0.001*	0.491	0.241	0.231
14	Boys	123.083	1.92	1.076	2.764	<0.001*	0.482	0.233	0.221

*Statistically Significant

Table 4: Regression analysis to predict PEFR based on height in cm for girls.

Age (in years)	Sex	Constant	Beta	95% CI for beta		P value	R	R^2	Adj R^2
				Lower	Upper				
6	Girls	-165.52	2.506	1.478	3.535	<0.001*	0.604	0.365	0.35
7	Girls	-89.256	1.943	0.279	3.606	0.023*	0.35	0.122	0.1
8	Girls	-160.31	2.615	1.11	4.12	0.001*	0.432	0.187	0.171
9	Girls	24.023	1.227	0.344	2.111	0.007*	0.346	0.119	0.104
10	Girls	-35.536	1.729	0.644	2.813	0.002*	0.362	0.131	0.118
11	Girls	-120.69	2.399	1.502	3.296	<0.001*	0.484	0.235	0.226
12	Girls	-76.526	2.084	1.089	3.078	<0.001*	0.418	0.175	0.165
13	Girls	-264.17	4.023	2.094	5.951	<0.001*	0.451	0.203	0.191
14	Girls	474.778	-0.875	-2.938	1.188	0.4	0.102	0.01	-0.004

Table 5: Regression model summary-height in cm overall.

Variable	Constant	Beta	95% CI for beta		P value	R	R^2	Adj R^2
			Lower	Upper				
Height	-458.03	5.138	4.944	5.333	<0.001*	0.831	0.691	0.691

*Statistically Significant

From Table 4, The linear regression model for girls of age 6years, shows one centimeter increase in height there was 2.5% increase in PEFR with a constant (-165.5) and a 95% confidence interval 1.4 to 3.5, a lesser R^2=36.5% which was found to be statistically significant. For age 7 years, one centimeter increase in height there was 1.9% increase in PEFR with a constant (-89.2) and a 95% confidence interval 0.2 to 3.6, a lesser R^2=12.2% and was statistically significant. For age 10 years, one centimeter increase in height there was 1.7% increase in PEFR with a constant (-35.5) and a 95% confidence interval 0.6 to 2.8, a lesser, R^2=13.1% and was found to be statistically significant.

From Table 5, The linear regression model for PEFR with height of all age shows, one centimetre increase in height there was 5.1% increase in PEFR with a constant (-458.0) and a 95% confidence interval 4.9 to 5.3, a lesser R^2=69.1% which was found to be statistically significant. It is also presented in Figure 1.

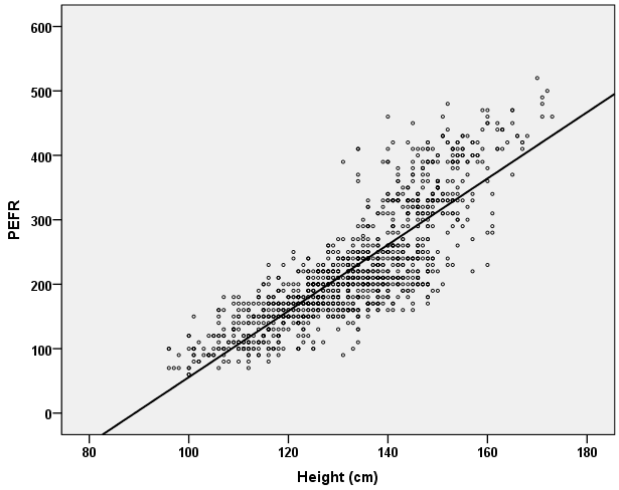

Figure 1: The scatter plot for PEFR and height with the line of best fit.

DISCUSSION

A vital part of respiratory medicine is the assessment of lung function; this is done 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".[7] In recent times, PEFR has rose in importance and is widely used for the evaluation of obstructive and restrictive lung diseases.[8]

Many studies report that various factors like geographical factors, exposure to environmental and occupational pollutions, and socioeconomic status can influence intraindividual variation of PEFR.[9] Additionally, height, weight, age, race, and past and present health, are some of the factors that can cause interindividual variation.

The present study was conducted among 1205 children aged between 6 and 14 years to measure and record their PEFR values and correlate it with their heights. The results show that with one centimetre increase in height there was 5.1% increase in PEFR. It also shows that mean PEFR for boys increased with their age and was greater than girls and that mean height for boys increases with their age with small difference compared to girls. These results are consistent with the findings of the studies conducted by different authors.[10-13]

This increase in PEFR with height may be attributed to the greater chest volume in taller subjects. Also, it is known that the growth of the airway passages and the expiratory muscle effort increase with an increase in the height.

CONCLUSION

Hence, we conclude from this study that a positive correlation exists between PEFR values and height.

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