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Original Research Article

"A STUDY ON PEAK EXPIRATORY FLOW RATE IN SCHOOL CHILDREN AND FACTORS AFFECTING IT"

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ABSTRACT

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

Objectives:

1. To determine the PEFR value in healthy school children from 8-18 years of age.
2. To study the effect of factors like age, sex, height and weight on PEFR.
3. To establish the correlation of PEFR values with age, sex, height and weight.

MATERIAL & METHODS:

This is a Prospective and Observational study conducted in Department of Pediatrics, Narayana Medical College, Nellore over a period of 1 year. Study population: Children of age group 8-18 years of both sexes were selected from various schools. Sample size: A total of 2200 were included in the study. Age was taken as completed years as on the school/college records. The children were subjected to fill clinical assessment. The anthropometric measurements taken were height and weight. Weight was measured in Kilogram (Kgs) using standard weighing machine.

Results: as age, height and weight have significant correlation with PEFR; multivariate analysis was performed using these independent variables for PEFR estimation. For boys: PEFR = 20.7 (age) 1.43(height) + 0.5 (weight)-158. For girls: PEFR = 11.6 (age) + 2.34(height) +0.31 (weight) -189

CONCLUSION: Peak expiratory flow rate measurement is a reliable, simple and inexpensive method of assessing the severity of airway obstruction in a child with obstructive airway diseases like asthma. It is of considerable value in monitoring prediction of exacerbation and monitoring of therapeutic efficacy.

Keywords: Peak expiratory flow rate, normal school children, respiratory diseases

INTRODUCTION:

Respiratory diseases are the leading cause of sickness in both developed and developing countries. Bronchial asthma during childhood is a 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 is also increasing.

PEFR recording is one among the many lung function tests useful in evaluation, monitoring, management and follow-up of patients with bronchial asthma. PEFR is easily measured using peak expiratory flow meter and can be recorded by the patients at home by themselves and at the clinic to reflect the severity of the outflow obstruction. It was shown to anticipate early deterioration of patients clinical condition before it actually happens. [1]

Bronchial asthma is one of the common respiratory disease of childhood which is associated with fluctuation in airway caliber, the earliest sign of bronchospasm is fall in PEFR[2]. PEFR is a well accepted index of pulmonary function and also personal best PEFR is a useful concept for asthma self-management plan. Serial PEFR monitoring is a convenient method for investigation and diagnosis of bronchial asthma. A variation of PEFR greater than 20 percent of baseline may indicate airway hyper reactivity.

Predictive normal values PEFR are essential for clinical interpretation of lung function tests. Normograms predicting PEFR from anthropometric measurements are available for various population groups.

While using lung function tests in epidemiology, it is important to ensure that the population from which the regression equation is derived is an appropriate one as predicated normal values are affected by many factors including ethnic, regional and environmental influences [3].

I hence the study was taken with the following objectives.
Objective:

1. To determine the PEFR value in healthy school children from 8-18 years of age.
2. To study the effect of factors like age, sex, height and weight on PEFR.
3. To establish the correlation of PEFR values with age, sex, height and weight.

MATERIAL & METHODS:

This is a Prospective and observational study conducted in the department of Paediatrics, Narayana Medical college, Nellore over a period of 1 year.

Study population: Children of age group 8-18 years of both sexes were selected from various schools including urban & rural.

INCLUSION CRITERIA: Children of age group 8-18 years of both sexes.

EXCLUSION CRITERIA:

a) H/o acute respiratory tract infection within preceding three weeks.
b) H/o chronic respiratory disease, asthma
c) H/o skeletal deformities of thorax
d) H/o cardiac and neurological disease
e) H/o smoking in adolescents

Age was taken as completed years as on the school /college records. The children were subjected to full clinical assessment. The anthropometric measurements taken were height and weight. Weight was measured in kilograms (Kgs) using standard weighing machine. Weight was taken without footwear and with light clothes. Standing height was measured by making the child to stand against a fixed calibrated rod with adjustable headrest. Height was measured without foot wear and children standing erect, looking forward with feet closed, head and body touching the rod. The measured height was then corrected to nearest centimeter. Children who were found as malnourished as per IAP criteria were excluded fromthe study.

PEFR was measured by mini Wright's peak flow meter (60-800 L/min). Instrument is a plastic cylindrical tube with a graduated scale on the surface and a mouth piece. Graduation starts with 50 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 o1 PEFR were taken in standing position.
The procedure was repeated thrice, highest value of these 3 readings was taken as observed PEFR. Disposable mouth piece were used for recording of PEFR.
Effect of factors like age, sex, weight and height on PEFR was studied.

Regression analysis was used to calculate the predicted normal values of PEFR and also toassess its relation to age, sex, weight and height.

OBSERVATIONS & RESULTS:

Table 1: MEAN WEIGHT, SD & ITS RELATION WITH PEFR IN BOYS

AGE (Yrs)	n	MEAN WEIGHT (Kgs)	SD	r	REGRESSION EQUATION FOR PEFR
8	100	20.6	3.1	0.418	147 + 3.19 (Wt)
9	100	23.8	3.5	0.446	189 + 1.80 (Wt)
10	100	26.4	3.8	0.019	246 - 0.08 (Wt)
11	100	29.9	5.2	0.500	194 + 3.06 (Wt)
12	100	31.6	4.8	0.486	246 + 2.30 (Wt)
13	100	34.1	7.4	0.497	274 + 2.50 (Wt)
14	100	42.0	8.4	0.492	343 + 2.00 (Wt)
15	100	46.1	8.7	0.031	428 + 0.14 (Wt)
16	100	47.2	7.1	0.031	453 + 0.16 (Wt)
17	100	48.6	5.7	0.111	507 - 0.71 (Wt)
18	100	51.2	4.0	0.128	421 + 1.10 (Wt)

In order to know the relation between weight and PEFR, correlation coefficient determined for each weight with corresponding age. It can be seen that in all age group PEFR was positively related with weight. Using this relationship, PEFR was predicted for each age group corresponding to mean weight. It can be seen that PEFR steadily increases with increase in weight.

PEFR = 7.47 (Wt) + 83.5, r = + 0.858.

Table 2: MEAN WEIGHT, SD & ITS RELATION WITH PEFR IN GIRLS

AGE (Yrs)	n	MEAN WEIGHT (Kgs)	SD	r	REGRESSION EQUATION FOR PEFR
8	100	20.6	3.1	0.550	130 + 3.83 (Wt)
9	100	24.8	3.5	0.138	201 + 0.72 (Wt)
10	100	26.8	4.2	0.196	218 + 6.77 (Wt)
11	100	28.5	4.7	0.459	191 + 1.70 (Wt)
12	100	34.3	5.2	0.061	300 + 0.25 (Wt)
13	100	36.1	5.9	0.290	263 + 1.71 (Wt)
14	100	38.9	6.4	0.159	324 + 0.61 (Wt)
15	100	43.8	8.6	0.020	354 + 0.08 (Wt)
16	100	46.9	7.1	0.003	376 - 0.01 (Wt)
17	100	48.1	6.6	0.010	376 + 0.03 (Wt)
18	100	48.1	6.7	0.141	351 + 0.74 (Wt)

In order to know the relation between weight and PEFR, correlation coefficient determined for each weight with corresponding age. It can be seen that in all age group PEFR was positively related with weight. Using this relationship, PEFR was predicted for each age group corresponding to mean weight. It can be seen that PEFR steadily increases with increase in weight.

PEFR = 5.11 (Wt) + 123, r = + 0.797

Table 3: MEAN HEIGHT, SD & ITS RELATION WITH PEFR IN BOYS

AGE (Yrs)	n	MEAN HEIGHT (Cms)	SD	r	REGRESSION EQUATION FORPEFR
8	100	122.1	5.2	0.803	- 174 + 3.11 (Wt)
9	100	128.7	3.7	0.585	- 56.2 + 2.24 (Wt)
10	100	132.3	3.9	0.021	256 - 0.08 (Wt)
11	100	139.1	6.7	0.759	- 218 + 3.62 (Wt)
12	100	141.9	6.7	0.580	38.3 + 1.98 (Wt)
13	100	146.4	7.5	0.507	- 5.1 + 2.49 (Wt)
14	100	156.1	9.0	0.380	201 + 1.45 (Wt)
15	100	160.1	9.3	0.089	375 + 0.37 (Wt)
16	100	164.1	6.9	0.013	471- 0.06 (Wt)
17	100	164.8	5.9	0.120	595 - 0.74 (Wt)
18	100	167.0	5.8	0.074	555 - 0.46 (Wt)

It can be seen that PEFR steadily increases with increase in height.
PEFR = 5.6 (Wt) - 474.4, r = + 0.902

Table 4: MEAN HEIGHT, SD & ITS RELATION WITH PEFR IN GIRLS

AGE (Yrs)	n	MEAN HEIGHT (Cms)	SD	r	REGRESSION EQUATION FOR PEFR
8	100	122.1	5.2	0.755	- 178 + 3.17 (Wt)
9	100	129.2	3.8	0.037	241 - 0.17 (Wt)
10	100	133.2	6.3	0.385	117 + 0.89 (Wt)
11	100	135.5	5.9	0.153	226 + 0.09 (Wt)
12	100	143.8	5.1	0.233	166 + 0.99 (Wt)
13	100	145.7	4.3	0.434	- 193 + 3.55 (Wt)
14	100	150.6	5.1	0.556	- 56.3 + 2.68 (Wt)
15	100	152.5	4.1	0.613	- 441 + 5.23 (Wt)
16	100	152.9	2.4	0.221	- 135 + 3.34 (Wt)
17	100	153.7	4.7	0.100	292 + 0.55 (Wt)
18	100	154.1	5.4	0.200	185 + 1.31 (Wt)

It can be seen that PEFR steadily increases with increase in height.
PEFR = 5.30 (Wt) - 451, r = + 0.876

Table 5: MEAN PEFR & STANDARD DEVATION IN BOYS

AGE (Yrs)	N	MEAN PEFR (L/min)	SD
8	100	208.5	21.7
9	100	231.5	14.0
10	100	244.3	16.4
11	100	286.0	31.8
12	100	319.1	22.8
13	100	359.6	37.1
14	100	427.2	34.3
15	100	434.9	39.1
16	100	460.3	36.8
17	100	472.4	36.8
18	100	477.2	36.5

It can be seen that mean PEFR is increasing as the age increases in boys.

Table 6: MEAN PEFR & STANDARD DEVATION IN GIRLS

AGE (Yrs)	N	MEAN PEFR (L/min)	SD
8	100	208.5	21.7
9	100	218.4	18.4
10	100	236.4	14.6
11	100	239.2	17.6
12	100	308.8	21.6
13	100	324.2	34.8
14	100	347.6	24.4
15	100	357.5	34.6
16	100	374.9	35.9
17	100	377.8	34.7
18	100	386.3	35.4

It can be seen that mean PEFR is increasing as the age increases in girls.

It can be seen that PEFR increases as the age increases. Boys had higher levels of mean PEFR than girls except eight years of age where both have a same mean PEFR value of 208.5 L/min.

It is also seen that difference in mean PEFR of boys and girls was found to be increasing more widely as age increases from fourteen years. In girls there is no much increase in PEFR as age increases from fourteen years.

As age, height and weight have significant correlation with PEFR; multivariate analysis was performed using these independent variables for PEFR estimation.

For boys: PEFR = 20.7 (age) + 1.43(height) + 0.5 (weight)-158 For girls: PEFR = 11.6 (age) + 2.34(height) + 0.31(weight)-189

Height showed a steady relationship with PEFR. As height increases PEFR increases progressively in both boys and girls. (r = + 0.892)

PEFR also showed positive correlation with weight (r = + 0.800). But to a lower degree thanheight (r = + 0.892).

DISCUSSION:

As the lungs in children are still growing no single value can be considered as normal for pediatric age group. Most of the lung functions have wide range of normal values. Predictive normal values correlates significantly with age, height and weight. Regression equations are therefore drawn from study of normal population.

In the present study we have selected children from 8 -18 years of age who are considered as healthy by ruling out the other systemic disease. PEFR was recorded using mini Wright's peak flow meter. The obtained PEFR results were analyzed as follows.

In our study, in boys the mean PEFR was 231.5 L/min, 359.6 L/min, 460.3 L/min and in girls mean PEFR was 218.4 L/min, 324.2 L/min. and 374.9 L/min at 9 years, 13 years and 16 years respectively, indicating boys had higher value of PEFR than girls at any given age.

A study conducted in children of Mysore district showed, PEFR values ranging from 285.45 L/min ± 87.22 L/win in 7 - 9 years and 375.2 L/min ±97.04L/min 13 - 15 years for boys and 201.33 L/min ± 25.53 L/min in 7 - 9 years and 384.78 L/min ± 53.15 L/min in girls.[4]

A study conducted in south Indian school children showed mean PEFR values 201 L/min in 89 years and 333 L/min in 14 - 15 years for boys. 197L/min in 8 - 9 years and 300 L/min in 14 – 15 years for girls[2]. A study revealed mean PEFR values of 186.4 L/min in 8 - 9 years and 320.4 L/min in 11 -12 years for boys. 178.8 L/min in 8 - 9 years and 289.4 L/min in 11-12 years for girls[5]. These studies indicate positive correlation between age and PEFR. As age increases PEFR levels increases. At a given age boys had higher levels of PEFR than girls.

PEFR values from Punjab school children were at higher levels compared to present study. These studies have slight variation in the PEFR at different heights[6]. PEFR values from Dublin (Western) school children were at higher levels compared to present study[7].

In our study PEFR increases with increase in weight both in boys and girls. In boys the mean PEFR varies from 244.3 L/min in 26.4 Kgs to 434.9 L/min, in 46.1 Kg where as in girls PEFR varied between 236.4 L/min in 26.8 kgs to 357.5 L/min in 43.8 kgs. A study showed mean PEFR levels of 237 L/min in weight range 20 - 25 kgs and 430 L/min in 45 - 50 Kgs for boys, PEFR of 225 L/min in weight range of 20 - 25 kgs and 431 L/min in 45 - 50 kg for girls[7].

From the observations of our study it is noticed that PEFR increases with increase in height and highest correlation was obtained between PEFR and height. (r = + 0.902 for boys, r = + 0.876 for girls).

The regression equation based on height for both sexes were Boys: PEFR = 5.63 (Height) - 474.43

Girls: PEFR = 5.30 (Height) - 451

It was seen that the regression equation for PEFR with height as the Independent variable wasthe best predictor of PEFR. This observation from our study correlates well with the studies done by the following.
Studies done by Sharma et al, showed PEFR has significant correlation with height (r = + 0.85 for boys, r = + 0.87 for girls) [8]. Studies done by Kashyap et al, showed PEFR has significantcorrelation with height. (r = + 0.893 for boys, r =+0.88 for girls).[9]

Our study showed increase in PEFR levels with increasing age. Boys had higher levels of PEFR than girls except 8 years of age where the both sexes have a same PEFR level of 208.5 L/min. It was noticed that difference in PEFR values of boys and girls was increasing more widely as age increases from 14 years. In girls after 14 years of age there is no much increase in PEFR levels. This can be explained by the fact that there is no much increase in height after puberty in girls.

A study showed a significant correlation between PEFR and height, weight and age. PEFR levels were marginally higher in prepubertal boys than girls. The boys continued to show an increase in PEFR until the age of 19 years.[10]

A study revealed mean PEFR levels were higher in boys than girls and this was more significant during puberty. Difference in PEFR increased between two sexes after the age of 11 due to faster increase of height in boys[11]. Study revealed that PEFR levels reached a plateau effect after the age of 13 years in girls whereas boys did not showed a similar effect.[12]
A study revealed there was significant increase in the slope of PEFR/Age line at 12 years in girls which continued for 2 years. Change in the slope was significant ($P<0.001$) there was a little increase in PEFR after this among girls. Among boys this change occurred at 14 years, there was continued increase in PEFR among boys up to 19 years of age.[13]

CONCLUSION:

Peak expiratory flow rate measurement is a reliable, simple and inexpensive method of assessing the severity of airway obstruction in a child with obstructive airway diseases like asthma. It is of considerable value in monitoring prediction of exacerbation and monitoring of therapeutic efficacy.

REFERENCES:

1. Al-Dawood K. Peak expiratory flow rate in Saudi schools boys at Al- Khobar City, Saudi Arabi, Saudi Medical Journal 2000; 21(6): 561-564.
2. Swaminathan S, Venkatesan P, Mukunth R. Peak expiratory flow rate in South Indian Children, Indian Pediatr 1993; 30(2): 207-211.

3. Seaton A, Seaton D, Leiteh GA. Epidemiology and respiratory diseases. In:Crofon and Douglas respiratory diseases, 4th ed., UK: Blackwell Science Oxford; 1989. P. 90.
4. Veeranna N, Rao KR. A study of peak expiratory flow rates among tribal children of mysore district J Indian Med Assoc July 2004; 102(7): 357-359.
5. Pande AH. Prediction of peak expiratory flow rate from height and weight. Indian I Pediatr 1986; 5 :521-523.
6. Malik SK, Jindal SK, Sharda PK, Banga N. Peak expiratory flow rate of healthy school boys from Punjab. Indian Peditr 1981; 18:517-521.
7. Carson JWK, Hoey H, Taylor MRH. Growth and other factors affecting peak expiratory flow rate. Arch Dis Childhood 1989; 64:96-102.
8. Sharma R, Jain A, Arya A, Chowdhary BR. Peak expiratory flow rate of school going children aged 5-14 years from Ajmer District. Indian Peditr 2002; 39:75-78.
9. Kashyap S, Puri S, Bansal K. Peak expiratory flow rates of healthy trial children living at high attitudes in the Himalayas. Indian Peditr 1992; 29:283-286.
10. Udupihille M. Peak expiratory flow rate in Srilankan school children of Sinhalese Ethnic origin. Respite Med Mar 1994; 88(3): 219-27.
11. Gharagozlo M, Khajooe V, Moin M, Rezvani M. Peak expiratory flow rate in healthychildren from Tehran. IJMS Mar 2003; 28(1):26-28.
12. Pande JN, Mohan A, Khilani S, Khilani GC. Peak expiratory flow rate in school goingchildren. Indian J Chest Dis Allied Sic 1997: 39:87-95.
13. Sadler T.W. Respiratory system. In: Langman's medical embryology, Chapter-13, 10th Ed., India: Lippincott William & Wilkins; 2006.P.195-201.