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### **Peak Expiratory Flow Rate in school children aged 8-18 years in Amritsar, Punjab**

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#### **Abstract**

Peak expiratory flow rate (PEFR) is considered to be a simple and reliable index of pulmonary function test to assess the ventilatory functions of lungs. It is a simple and reliable method of assessing the disease progress and response to treatment. This study was conducted on 1000 school children in Amritsar Punjab .We concluded that Wright's mini peak flow meter is a useful, reliable, inexpensive and portable instrument for recording of peak expiratory flow rate in children. We can calculate PEFR of children aged 8-18 years with the derived regression equations in both genders i.e Regression equation for PEFR according to Age, Height and Weight are : For Boys:  $PEFR = 21.15 (Age) + 3.53 (height) - 3.37 (Weight) - 234.47$

For Girls:  $PEFR = 25.69 (Age) + 1.33 (height) - 2.12 (Weight) - 37.78$

We have now PEFR charts for 8-18years of both genders and they can be used for children of Amritsar.

**Keywords:** PEFR, Wright's mini peak flow meter.

#### **Introduction**

PEFR is defined as the maximal expiratory flow rate which can be sustained by a subject for at least 10 milliseconds during forced expiration starting from total lung capacity. PEFR is expressed in litres/min. The Peak expiratory flow rate measurement is simple, reliable and reproducible way of judging the degree of airway

obstruction in various obstructive and pulmonary diseases, especially asthma.<sup>1</sup> Pulmonary function is known to vary with age, sex, height, weight, race and geographical location. The Peak Flow Meter is a useful instrument that is widely used for PEFR measurement on an ambulatory basis. Peak Expiratory Flow Rate (PEFR) has gained worldwide acceptability as a method for

identification, assessment, rational therapy and follow up of patients with asthma, bronchitis, emphysema and other COPDs (Chronic Obstructive Pulmonary Disorders). Studies of PEFr in children have been done in certain cities in India and normal curves have been plotted. The studies have been confined to particular geographical area, city and extrapolation of the studies to include whole of India would be inappropriate. Studies involving long term use of mini Wright peak flow meter, has performed well for many months and with as many as 4000 blows<sup>2</sup>. Scanty data is available for PEFr in school children in and around Amritsar. These values would be highly useful for better control of asthma and chronic obstructive pulmonary disease

### Aims and Objectives

1. To study Peak expiratory flow rate in healthy school children aged 8-18 yrs in Amritsar, Punjab.
2. To obtain PEFr data so that it can be used as reference in children.

### Materials and Methods

The present cross sectional study was conducted from August 2016 to January 2017 and a total of 1000 school going healthy children were studied under Department of Tuberculosis and Respiratory Diseases, Government Medical College, Amritsar. Permission by ethical committee of college was taken. Three Government schools were regularly visited once a week.

### Inclusion criteria

1. Students of age group 8 to 18 years.
2. Both gender.
3. Healthy children.

### Exclusion criteria

1. Any respiratory illness.
2. Children having history of (h/o) any febrile illness in the last 3 weeks.
3. Upper respiratory tract infections (URTI)-like symptoms in the past 3 weeks.

4. History of asthma.
5. Any major systemic disease like cardiac or renal problems.
6. H/o any drug intake which can affect PEFr.
7. H/o any allergy.
8. Children with bone deformity of chest or spine and any muscular weakness.

Information was noted on Performa which included

**1. Age:** Age of each child was recorded as a number of completed years and was noted according to date of birth registered in school records.

**2. Weight:** The Weight of every child was recorded in kilograms with minimal clothing and without shoes.

**3. Height:** The height of every child was recorded in standing posture without shoes, recorded in centimetres by stadiometer.

**4. Peak exploratory flow rate:** Peak exploratory flow rate was measured using Wright's mini peak flow meter in standing position. This instrument was used to obtain PEFr values from all the schools. Every child was asked to inhale the maximum and then exhale forcibly in peak flow meter. Three readings were taken in three successive attempts and highest reading was taken on record.<sup>2</sup>The data was collected, was analysed by SPSS software and conclusion were drawn.

### Results

A total of 1000 school children were studied in the present study, which included 500 boys and 500 girls.

Table (I) Age wise distribution of children

Age (years)	Frequency	Percent
8	104	10.4
9	96	9.6
10	65	6.5
11	73	7.3
12	63	6.3
13	62	6.2
14	92	9.2
15	144	14.4
16	116	11.6
17	98	9.8
18	87	8.7
Total	1000	100.0

As shown in Table (I) Maximum number of children were in age group 15 years 144(14.4%) followed by 16 years 116 (11.6%) and 8 years

104 (10.4%). Minimum number of children were of 13 years 62 (6.2%).

Table (II) Height wise distribution of children

Height (cm)	Frequency	Percent
110-120	2	0.2
121-130	99	9.9
131-140	150	15.0
141-150	102	10.2
151-160	647	64.7
Total	1000	100.0

As shown in table (II) the height of children in various groups are recorded in cm. It shows maximum number of children are in height group

151-160 cm 647(64.7%), followed by 131-140 cm 150(15%). Minimum number of children are in age group 110-120cm 2 (0.2%).

Table ( III) Weight wise distribution of children

Weight (kg)	Frequency	Percent
20-30	162	16.2
31-40	162	16.2
41-50	136	13.6
51-60	284	28.4
61-70	246	24.6
71-80	10	1.0
Total	1000	100.0

As shown in table (III) maximum number of children are in weight category 51-60 kg 284(28.4%), followed by weight category 20-

30kg 162 (16.2%) and 31-40 kg are 162 (16.2%).Minimum number of children are in 71-80 kg group 10(1%).

Table ( IV)Mean PEFR in relation to height group

Height (cm) (PEFR)	Sex	N	Mean±S.D.	Significance
110-120	Male	2	230.00	.000
	Female	-	-	
121-130	Male	48	272.29	.000
	Female	51	263.53	.000
131-140	Male	69	346.38	.000
	Female	81	320.74	.000
141-150	Male	36	421.11	.000
	Female	66	386.97	.000
151-160	Male	345	491.16	.000
	Female	302	440.00	.000

Table IV shows Mean PEFR±SD of children in relation to Height groups, with male and female distribution separately and their significance. Height group 121-130cm mean PEFR±S.D. values in males 272.29±48.78 and in females 263.53±31.61. In 131-140cm height group mean

PEFR in males 346.38±63.94 and in females 320.74±40.55. In 141-150 cm height group mean PEFR in males 421.11 whereas in females 386.97 and in height group of 151-160cm mean PEFR values for male is 491.16±47.91 and in female 440.00±59.15.

Table (V) Showing mean PEFR in relation to weight

Weight group	Sex	N	Mean±Std. Deviation	Sig
20-30	Male	73	290.41±64.127	.000
	Female	89	275.96±34.203	.000
31-40	Male	70	375.86±61.018	.000
	Female	92	365.87±36.349	.000
41-50	Male	46	428.26±66.007	.000
	Female	90	380.56±36.700	.000
51-60	Male	83	460.00±45.719	.000
	Female	201	453.23±48.979	.000
61-70	Male	218	511.01±25.507	.000
	Female	28	509.64±22.523	.000
71-80	Male	10	525.00±11.785	.000
	Female	0		

Table V shows weight (kg) in groups, PEFR Mean±Std. Deviation of males and females and their significance. In weight group 20-30kg PEFR Mean±S.D of males is 290.41±64.127 and their

sig value.000, in females PEFR Mean±S.D 275.96±34.203 and their sig value.000. Similarly in other weight groups.

Table (VI) Mean PEFR in various age group (Male)

	Age group	Number of patients	PEFR(Mean±S.D).	Sig
PEFR	8	53	259.06±33.355	.000
	9	47	360.64±57.309	.000
	10	20	353.50±53.536	.000
	11	20	432.50±31.267	.000
	12	27	404.81±56.729	.000
	13	23	445.65±67.408	.000
	14	33	430.30±51.325	.000
	15	96	481.15±23.703	.000
	16	77	510.78±17.073	.000
	17	48	520.21±16.307	.000
	18	56	531.61±14.242	.000
	Total	500	444.08±91.602	.000

Above table VI shows relationship between age in years and PEFR Mean ±S.D. and their significance in Males. In 8 years PEFR Mean

±S.D is 259.06±33.355 and significance.000. Whereas in 18 years PEFR Mean ±S.D is 531.61±14.242 and significance.000

Table (VII) Mean PEFR as per age (Female)

	Age group	Number of patients	PEFR (Mean±S.D).	Significance
PEFR	8	51	265.49±32.454	.000
	9	49	294.08±30.064	.000
	10	45	356.44±22.779	.000
	11	53	395.66±27.492	.000
	12	36	357.50±34.672	.000
	13	39	379.49±22.472	.000
	14	59	417.63±27.376	.000
	15	48	442.08±38.369	.000
	16	39	476.41±34.143	.000
	17	50	497.20±22.591	.000
	18	31	513.23±19.042	.000
	Total	500	395.68±80.630	.000

Above table VII shows relationship between age in years and PEFR Mean ±S.D. and their significance in Females. In 8 years PEFR Mean

±S.D is 259.06±33.355 and significance.000. In 18 years PEFR Mean ±S.D is 513.23±19.042 and significance is.000.

Table (VII) Correlation between age, height, weight and PEFR

	AGE	HEIGHT	WEIGHT	PEFR
AGE	1.000	0.947	0.960	0.870
HEIGHT	0.947	1.000	0.983	0.874
WEIGHT	0.960	0.983	1.000	0.867
PEFR	0.888	0.874	0.867	1.000

Above table VII shows coefficient of correlation between Age, Height, Weight and PEFR. Pearson correlation of Height is.874, whereas Age it is.870 and Weight.867 and Sig (2-tailed) value is.000 for all the three parameters i.e. age, height, and weight of 1000 children.

### Discussion

A total of 1000 children of age 8-18years of both genders were taken for study from three schools. Three readings of peak expiratory flow rate values were recorded of each child and highest out of three were taken for calculations. This has been justified by various authors who while estimating spirometrically FEV1 in children, on three maximum readings from each subject, found that 95% of the readings were within 3.8% of individual means.<sup>3</sup>

**Correlation of PEFR with Age:** It was observed in present study that PEFR increased with increasing age and highest values of PEFR obtained were in the age range of 17-18 years and it showed statistical significance (p value.000). This observation was consistent with studies conducted by other workers, though the age at which the maximum mean PEFR was reached is different. It was found that mean PEFR was highly significant with age in both males and females. It was found that PEFR was highly significantly positively co-related with age, height and weight in both male and female children<sup>4</sup>. PEFR increased with increasing age with highest at the age range of 14-17 years. A study on Ethiopian children recorded a sharp increase in PEFR with age, reaching a peak at 17-18 years in

males and somewhat earlier at 15-16 years in the female<sup>3</sup>. In a study of PEFR on Bangladeshi boys and girls, it was found that PEFR continued to rise in boys after 15 years but PEFR in girls seemed to have attained maximum values by that age<sup>5</sup>. Our study also showed similar results. This observation could possibly be justified due to rapid growth of airway passages and increase in muscularity as the age advances.

**Correlation of PEFR with weight:** It was observed in present study that PEFR increases as weight increases in both male and female children .In each weight group in both sexes, PEFR MEAN  $\pm$  S.D has shown statistical significance (p value.000). Weight correlated positively with PEFR. Mean PEFR is found to be more in boys as compared to girls in each weight group. This observation was similar to the observation of the authors of earlier studies<sup>6-12</sup>. as they also found weight significantly correlates with PEFR. This observation could possibly be due to rapid growth of airway passages and expiratory muscle effort as weight increases. This is due to increased muscle mass and growth of air passage.

**Comparison of PEFR values in Male and Female children:** Mean PEFR values have been compared among male and female children in different age groups . In the present study, mean PEFR in male children was higher than that of female children at all the age groups. PEFR values increased with increase in age in both male and female. These findings were found to be statistically significant (p value.000) in our study.

These findings were consistent with other previous studies.<sup>4,13,14</sup> Male children had higher PEFR values especially after the age of 10 years possibly because of better height, weight and rapid growth of airway passages as age advances, more muscular development and possibly due to the more expiratory muscle effort. Regression equation was obtained for boys and girls

separately as shown below which shows PEFR depends on Age, Height and weight as variables. It can be used as reference for predicting PEFR.

For Boys:  $PEFR = 21.15 (\text{Age}) + 3.53 (\text{height}) - 3.37 (\text{Weight}) - 234.47.$

For Girls:  $PEFR = 25.69 (\text{Age}) + 1.33 (\text{height}) - 2.12 (\text{Weight}) - 37.78.$

Table VIII: Regression equation for PEFR for height and weight

Variables	Regression Equation for PEFR	'r' values
Height (Boys)	$-276.61 + 4.50 (\text{Ht})$	0.877
Height (Girls)	$-393.87 + 5.20 (\text{Ht})$	0.853
Height (Entire)	$-331.32 + 4.81 (\text{Ht})$	0.874
Weight (Boys)	$170.43 + 5.22 (\text{wt})$	0.862
Weight (Girls)	$127.98 + 5.86 (\text{wt})$	0.857
Weight (Entire)	$147.10 + 5.56 (\text{wt})$	0.867

Table VIII shows regression equation for height and weight for boys and girls separately. We can calculate PEFR for any given height and weight as per derived formula. The r value is more for boys than girls in all weight groups as seen earlier

and combined seen now. r value when compared between height and weight shows that height is a more significant variable for determination of PEFR. Combined regression equation for Height is  $-331.32 + 4.81 (\text{Ht})$ .

Table (IX) Comparison of regression equation for peak expiratory flow rate according to height by different authors

Sr.No	Study	Subject	Regression equation for PEFR
1	Benjaponpitak S et al <sup>15</sup> 1999 Bangkok	M	$-186.80 + 3.52(\text{Ht})$
		F	$-204.11 + 3.48(\text{Ht})$
2	Wardha <sup>8</sup> 2008	M	$-257.86 + 3.64(\text{Ht})$
		F	$-346.51 + 4.7(\text{Ht})$
3	Sindhaur <sup>16</sup> 2014	M	$-392.37 + 5.15(\text{Ht})$
		F	$-351.24 + 4.83(\text{Ht})$
4	Mehta et al <sup>17</sup> 2016	M	$-218.38 + 3.29 (\text{Ht})$
		F	$-216.49 + 3.25 (\text{Ht})$
5	M Gavane J <sup>18</sup> 2017	M	$-917.3 + 8.91 (\text{Ht})$
		F	$-859.3 + 8.22(\text{Ht})$
6	Present study 2017 Amritsar	M	$-276.61 + 4.50(\text{Ht})$
		F	$-393.87 + 5.20(\text{Ht})$

Age, weight and height have been used either alone or in combination to predict PEFr values in the different studies. Regression equation for PEFr according to subjects height have been derived by different authors because height is easy to measure in the field as well as on bedside. In the present study, the regression equation for

PEFR according to subjects height was obtained separately for both boys and girls as shown in Table IX. The Regression equation obtained in the present study was comparable to the regression equation derived by different authors.<sup>4,15,16,17,18</sup>

Table (X) Comparison of regression equation for peak expiratory flow rate according to height by different authors

S No	Study		120cm	140cm	160cm
1	Taksande A et. A <sup>14</sup> , 2008 n=1078	M	212	318	423
		F	211	317	422
2	Mohammadzadeh et al <sup>19</sup> Iran n=1050	M	222	320	415
		F	216	314	412
3	Shallu mittal et.al <sup>9</sup> 2013 Punjab(India)	M	205	286	368
		F	193	272	350
4	Paramesh H et.al <sup>20</sup> , 2002 Bangalore	Common	200	300	400
5	Binu Abrahm et al <sup>21</sup> , 2014	M	160	230	-
		F	230	215	-
6	Manjunath CB et al, 2013 Bellur <sup>22</sup>	M	210	298	386
		F	188	273	358
7	Present study Amritsar 2017	M	263.39	353.39	443.39
		F	230.13	334.13	438.13

The prediction equations for PEFr were determined for boys and girls separately. The boys had higher values than the girls, the regression equation for PEFr based on height PEFr (Boys) = 276.61+4.50(Ht) whereas PEFr for (Girls) = -393.87 + 5.20(Ht) and PEFr (COMBINED) = 331.32 + -4.81 (Ht).Regression Equation for Height in different studies over different places and at different times are as shown in Table X. Our study done in GMC Amritsar showed more or less similar PEFr values with respect to height. The little difference might be due to an effect on environment and lesser anthropometric values among children in different region which could be geographic as well as genetic. Inter individual variability may be due to variety of host factors, including size, weight, height, age, race, past and present health, pollution and socio economic status may also influence the inter individual variation. Therefore it would be more appropriate for each region to have its own value.

## Conclusion

Our study concludes that Wright's mini peak flow meter is a useful, reliable, inexpensive and portable instrument for recording of peak expiratory flow rate in children. We can calculate PEFr of children aged 8-18 years with the derived regression equations in both genders. Regression equation for PEFr according to Age, Height and Weight are:

For Boys: PEFr = 21.15 (Age) + 3.53 (height) – 3.37 (Weight) – 234.47

For Girls: PEFr = 25.69 (Age) + 1.33 (height) – 2.12 (Weight) – 37.78.

We have now PEFr charts for 8-18 years of both genders and they can be used for children of Amritsar. The test of PEFr is highly useful when used serially, as in monitoring the course of treatment of bronchial asthma and many other respiratory diseases especially in children.



Children had no difficulty in understanding the use of the instrument. Hence Peak expiratory flow rate measurement with Wright mini peak flow meter was found to be a reliable bedside test which could be performed even in field.

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