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Peak expiratory flow rate (PEFR) among urban school children in Puducherry

Anitha A and V Raji Sugumar

Abstract
In many population based studies, Peak Expiratory Flow Rate (PEFR) is considered as a simple and useful screening method for persons with respiratory problems. PEFR may also vary with environment, region and anthropometric factors. The present study was aimed to construct a PEFR nomogram in normal urban school children (10-12yrs) in Puducherry.
Methodology: An exploratory study was conducted among 792 (432 boys and 360 girls) urban government school children who did not have any episode of respiratory discomforts during the past three month by adhering to sampling procedure of proportionate stratified random sampling method. PEFR was measured using Mini-Wright Peak Flow Meter and the highest among the three values was taken for consideration. Height, weight and chest circumference were measured using standard prescribed methods and tools. Correlation and linear regression analysis were used to formulate PEFR nomogram.
Results: Mean PEFR of 792 students who participated in the study was 324.7±66.1 L/Min (boys – 327.4 L/Min and girls – 319.9 L/Min). PEFR has strong positive correlation with age (r = 0.51, p<0.01), height (r = 0.98, p<0.01), weight (0.79, p<0.01). 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 was PEFR = 8.91 × height in cms – 917.30 (for every 1cm increase in height, PEFR increases by 8.91 L/Min) for boys and PEFR = 8.22 × height in cms – 859.3 (for every 1cm increase in height, PEFR increases by 8.22 L/Min) for girls.
Conclusion: Findings revealed that PEFR values showed linear relation to height, which being the best predicted variable. The nomogram constructed from the present study was found more or less similar with previously published data. Therefore, it would be more appropriate for each region and country to generate its own region reference values.

Keywords: Nomogram, peak expiratory flow rate (PEFR), school going children

1. Introduction
As per CAPE (Canadian Association of Physicians for the Environment, 2000) children are particularly vulnerable to respiratory infections for a number of reasons which include features of their developmental stage, physical differences from adults and aspects of their behaviour [7]. It is well documented in literature that respiratory problem became common in developing countries were more than four million deaths occur among children every year [12] and it is a major global health problem which exerts a substantial load on the family, health care services and on the society as a whole.
PEFR is considered as a simple index and useful screening method for persons with respiratory problems [5]. The peak flow meter is a reliable instrument for monitoring PEFR in children and adults. PEFR may also vary with region, genetic, exposure to environmental and occupational pollution, socioeconomic status and host factors like height, weight, age, race, post and present health [1, 2].
In several research studies, height is regarded as the most relevant variable for both sexes in predicting PEFR. Nomograms predicting the PEFR from height are available for Indian adults and children from both North and South (Pramesh H, 2003) [11] including in Tamil Nadu, but no such data is available for Puducherry. With this perspective, the present study was aimed to construct a PEFR nomogram in normal urban school children (10-12yrs) in Puducherry and to compare height and weight with PEFR.

2. Methodology

2.1 Study area and study subjects

A study was conducted in Urban Government schools of Puducherry during the period of six months (July to December 2013) after getting permission from Director of School Education. Stratified random sampling method was adopted to pick samples. Age in years was taken as inclusive criteria for picking samples and person with history of wheezing, cold and other respiratory infections for the past three months were excluded from the study, thus 792 school children who belonged to 10-12 years of age group were selected for the study.

2.2 Data collection

Prescribed standard equipments like stadiometer and weighing scale were used for assessing anthropometric measurements. Peak expiratory flow rate was measured using Mini-wright peak flow meter, which functions under the principles of Pressure and External force. This was used as an indicator for the assessment of respiratory problem (i.e. when the air is blown by the sample the point in the PEF instrument will move towards the end point and the resting point will be considered as the PEFR Value of the sample) and 60 L/min is the starting point of expiration and 900 L /min is the end point of expiration. After instruction to all students, at least three PEF was taken for each person, and the highest among the three values was taken for consideration.

2.3 Statistical analysis

The gathered data was analyzed using SPSS 17.0. Pearson correlation coefficients and linear regressions were performed by using age, weight and height as the independent variables and PEFR as the dependent variable.

3. Results

A total of 792 children, 432 boys and 360 girls aged 10 to 12 years were participated in the present study. The mean PEFR of boys were 327.4 ± 66.9 L/Min and girls were 319.9±74.4 L/Min). The mean anthropometric factors like age, height and weight were represented in Table I.

Table I: Anthropometric measurements of the study group

Study Group	N (%)	Age (Yrs.)	Weight(Kgs.)	Height (Cms.)	PEFR (L/Min)
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Boys	432 (54.5)	11.08±0.7	59.0±21.4	137.6±7.43	327.4±66.9
Girls	360 (45.5)	11.07±0.7	54.46±27.4	137.37±8.5	319.9±74.4
Both	792 (100)	11.08±0.7	57.37±23.02	137.5±7.9	324.1±69.4

Figure I depicts a strong positive significant (p<0.01) correlation (r = 0.51) between PEFR and age. Regression model was developed and summarizes that 24.2 percent of variability in PEFR is accounted for age (R square = 0.242). The prediction equation for PEFR = 41.99 × age in years – 152.9 (for every one year increase in age, PEFR increased by 41.99 L/min)

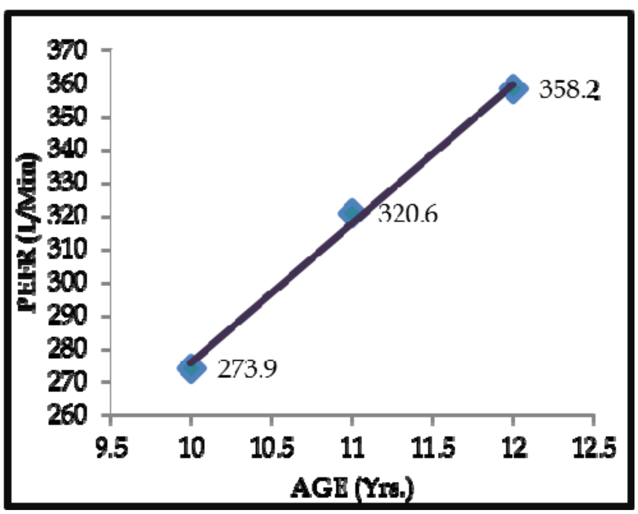

Fig I: PEFR (L/Min) values in relation to age

There was strong positive correlation (r=0.79) between weight and PEFR. From regression model, nearly 55.5 percent variability in PEFR is accounted for weight (R square = 0.545). The regression equation for PEFR based on weight was PEFR = 7.14 × weight in kg + 115.8 (for every 1kg increase in weight, PEFR increases by 7.14 L/Min) as represented in the Figure II

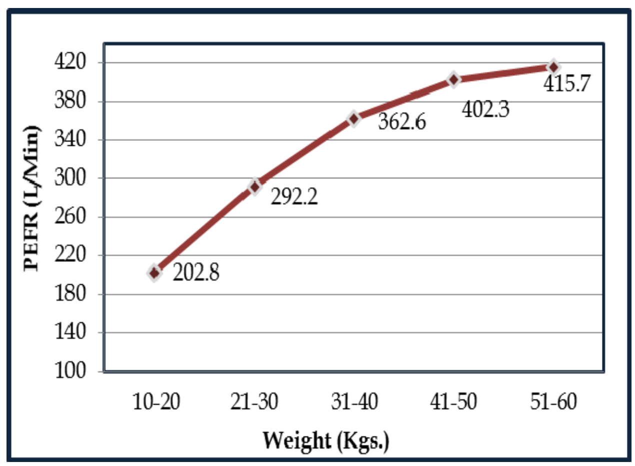

Fig II: PEFR (L/Min) values in relation to weight

Correlation of PEFR in relation to height was studied, there was a positive significant (p<0.01) correlation (r = 0.98). Regression 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 was PEFR = 8.91 × height in cms – 917.30 (for every 1cm increase in height, PEFR increases by 8.91 L/Min) for boys and PEFR = 8.22 × height in cms – 859.3 (for every 1cm increase in height, PEFR increases by 8.22 L/Min) for girls. Prediction model for entire sample group (N=871) revealed that R square = 0.926 (92.6 percent of variability in PEFR is accounted for height).
A nomogram has been constructed from the linear regression model (PEFR = 8.49 × height in cms – 862.4) by using PEFR as a dependent variable and height of both sexes as an independent variable (Figure III)

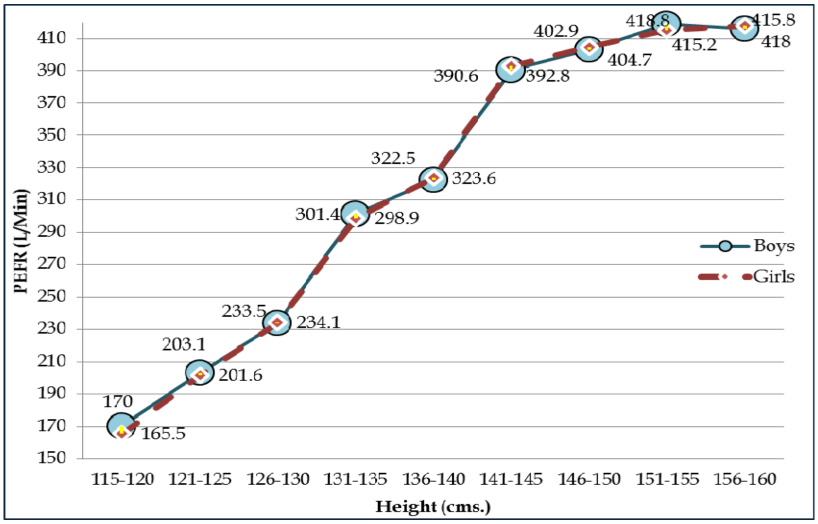

Fig III: PEFR (L/Min) values for boys and girls in relation to height

Table II shows the comparison of predicted PEFR values from the present study for three different heights with the PEFR values for the same height from five previous studies in India. PEFR values of children were found more or less similar to other North and Western Indian children.

Table II: Comparison of PEFR (L/min) of the present study with other studies

Height (cms.)	Present study Puducherry		Paramesh H *et al.*, 2002 Bangalore	Kalyan Brata Mondal *et al.*, 2009 Kolkata		Manjunath CB *et al.*, 2013 Bellur		Shallu Mittalet *et al.*, 2013 Punjab		Binu Abraham *et al.*, 2014 Kerala	
	B	G	Common	B	G	B	G	B	G	B	G
120	174	169	200	246	211	210	188	205	193	160	150
140	286	282	300	314	265	298	273	286	272	230	215
160	397	391	400	384	324	386	358	368	350	-	-

4. Discussion

The mean anthropometric parameters of 792 urban government school children (10-12yrs) from five different schools were measured to understand the standard values of Puducherry children (Table I). The present study found the difference of values of PEFR (L/Min) between boys and girls in relation to age, height and weight. The difference of PEFR values in both the sexes were also observed by other investigators in which boys showed significantly higher values than girls [2, 4, 6]. It might be the fact that PEFR depend on expiratory muscle effort, lung elastic recoil pressure and air way size which are relatively higher for males.

Kalyan Brata Mondal *et al.* [8], also observed that PEFR values in children were gradually increased with age which is comparable to the present study. But some studies in adults observed that PEFR values did not increase with age rather it got decreased [4, 14].

PEFR has strong positive correlation with age (r = 0.47, $p<0.01$), height (r = 0.95, $p<0.01$), weight (0.74, $p<0.01$). Iraj Mohammad zedeh *et al.* [5], measured the PEFR of normal children from the town of Babool Iran and found that the obtained PEFR with all anthropometric variants indicate a high correlation as similar to the present study. The most significant correlation was observed between height and PEFR. Therefore height serves as a basic and relevant variable for constructing regression equation for predicting PEFR because it is convenient measurements and its assessment is accurate if proper technique is used [4, 9, 16].

A nomogram has been constructed (PEFR = 8.17 × height in cms – 802.02) by using PEFR as a dependent variable and height of both sexes as independent variables. Such nomograms also were formulated by several other researchers [15, 10].

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 was PEFR = 8.91 × height in cms – 917.3 (for every 1cm increase in height, PEFR increases by 8.91 L/Min) for boys and PEFR = 8.22 × height in cms – 859.3 (for every 1cm increase in height, PEFR increases by 8.22 L/Min) for girls. The observation of the present study was also comparable to the findings of other studies [2, 4, 9].

When compared with studies from Western and Northern India [3, 8, 10, 11, 13] children from Puducherry (present study) exhibited 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 of South India which could be geographic as well as genetic.

5. Conclusion

In the present study, height seemed to be the best predictor of PEFR. Age and body weight correlated with PEFR but not as good as height. In both boys and girls, PEFR values increased with height, age and weight but PEFR values of girls were significantly lower than that of boys. The lower PEFR values in girls could be an effect of lower lung volume due to a smaller chest size.

Generally, we all refer to common international references for obtaining different normal values. It has been shown that PEFR values vary with racial, socio-economic, life styles, genetic and anthropometric factors. Therefore, it would be more appropriate for each region and country to generate its own regional reference values

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