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Original Research Article

Correlates of peak expiratory flow rate and deriving the prediction equation in school going children of Lucknow

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ABSTRACT

Background: Peak expiratory flow rate (PEFR) is an essential measure in the monitoring and evaluation of airway obstruction in asthmatic children. Studies on PEFR in children are limited. The objectives of the study were to evaluate PEFR in healthy school going children and its correlation with age, weight, height and Body Surface Area and to derive their prediction equations.
Methods: We conducted a cross-sectional study in 1200 healthy school children age group of 5-15 years after approval from the institutional Ethical committee. All the analysis was carried out by using SPSS version 16.0. Pearson correlation coefficient was calculated to find the correlation between PEFR and anthropometric parameters among boys and girls.
Results: PEFR was higher in boys than girls among all age groups except for 5 years of age. PEFR prediction equations were obtained both for boys and girls using multiple regression equations. For boys: 4.21* age in years^{2} +0.68* height in cms– 2.48* weight in kg +322.85* BSA^{3} –137.88 and for girls: 10.64* age in years^{1} +0.25* height in cms +0.09* weight in kg + 99.44* BSA -22.41 (^{1}p=0.0001, ^{2}p=0.001, ^{3}p=0.007).
Conclusions: We developed PEFR prediction equations in children using weight, height, and body surface area. This would be helpful in evaluation of children with airway diseases.

Keywords: Peak expiratory flow rate, Asthmatic, Children

INTRODUCTION

Obstructive airway diseases are on a rise in children so assessment of pulmonary function test is very important.[1] They are overlooked owing to difficulties in measuring them at clinical set-ups and also because of expensive equipment required.[2,3] However, it can be easily measured using Peak Flow Meter which is a simple hand held device.

Peak expiratory flow rate (PEFR) measurement is a simple test of respiratory function used in diagnosis and follow-up of children with bronchial asthma. It primarily reflects large airway flow.[4] There are wide variations in PEFR with geographic, racial, genetic and nutritional background.[5,6]

However, for the meaningful interpretation observations specific to a population be compared with prediction equations developed in healthy children.[7] However increase in lung function with age is non-linear due to the pubertal growth spurt in.[8,9] Therefore, we planned a study to derive prediction equation for PEFR using many variables among healthy children.

METHODS

We conducted a school based cross-sectional study in 2015 in 1200 healthy school children of Lucknow.

Objective

The objectives of the study were to correlate PEFR of healthy children with age, weight, height and BSA and to derive their prediction equations. The study was approved by the Ethical committee of the Era Medical College.

Inclusion criteria

School going children aged 5-15 years.

Exclusion criteria

Children with history suggestive of any respiratory illness in preceding two weeks, known history of asthma, allergies and children who were not able to perform the procedure on repeated (more than three) attempts were excluded.

Six primary and two secondary schools were randomly selected out of 10 schools. The prior permission of school authorities was taken and informed written consent/assent from parent/guardian of the children was also obtained after clearly explaining them the purpose and objective of the study. Questionnaire was distributed to parents. A detailed history, followed by clinical examination was carried out.

Prior to recording the PEFR of students the use of instruments was demonstrated and explained. In standing position, each child blew three times without nose clip into Mini-wright peak flow meter (60-80 l/min). The highest of the three results obtained was taken as final PEFR of for each subject.

Age was taken as completed years as per the school records. Anthropometric measurements weight, height was taken and body surface area (BSA) was calculated.

Weight was measured with weighing scale to nearest 0.1 kg without shoes and with school uniform.

The height was taken without footwear against a non-stretchable tape fixed to a vertical wall Body surface area was calculated as $\sqrt{\frac{wt \times ht}{3600}}$

Statistical analysis

All the analysis was carried out by using SPSS 16.0 version (Chicago, Inc., USA). The results are presented in mean±SD. Unpaired t-test was used to compare the anthropometric and PEFR values between boys and girls. Pearson correlation coefficient was calculated to find the correlation between PEFR and anthropometric parameters among boys and girls. One way analysis of variance (ANOVA) followed by Tukey's multiple comparison tests was used to compare the PEFR. The multivariate regression equations were generated for the prediction of PEFR from the anthropometric parameters. $p<0.05$ was considered significant.

RESULTS

A total of 1006 children from 5-15 years were included in this analysis. There were 62.4% boys and 37.6% girls. The comparison of PEFR and anthropometric parameters between boys and girls is depicted in the Table 1. The mean age of boys and girls were 9.96±2.59 and 9.72±2.68 respectively. However, height, weight, BSA and PEFR were significantly (p=0.001) higher among boys than girls. A significant (p=0.0001) positive correlation was observed between PEFR and anthropometric parameters among both boys and girls (Table 2). The multivariate linear regression analysis was done for prediction equations of PEFR and depicted in the Table 3.

Table 1: Comparison of PEFR and anthropometric parameters between boys and girls.

	Boys (n=628)	Girls (n=378)	P value[1]
Age in years	9.96±2.59	9.72±2.68	0.16
Height	139.41±17.98	132.54±15.45	0.001*
Weight	30.57±11.41	26.60±9.08	0.001*
BSA	1.08±0.26	0.98±0.21	0.001*
PEFR	272.02±92.22	213.57±64.46	0.001*

[1]Unpaired t-test, *Significant

Table 2: Pearson correlation coefficient between PEFR and anthropometric parameters.

Anthropometric parameters	Male		Female	
	R value	P value	R value	P value
Age	0.68	0.0001*	0.77	0.0001*
Height	0.80	0.0001*	0.71	0.0001*
Weight	0.75	0.0001*	0.72	0.0001*
BSA	0.81	0.0001*	0.76	0.0001*

*Significant

Table 3: Multiple regression equations on the basis of age and height for predicting PEFR.

	Equation
Boys	4.21* age in years[2]+0.68* height in cms – 2.48* weight in kg +322.85* BSA[3]– 137.88
Girls	10.64* age in years[1] +0.25* height in cms +0.09* weight in kg + 99.44* BSA- 22.41

[1]p=0.0001, [2]p=0.001, [3]p=0.007, *Significant

DISCUSSION

Various studies have shown the variability of PEFR with age, sex, height. Our study shows positive correlation with age, weight, height and BSA. The present article presents prediction equations for PEFR for children of

north Indian origin between the ages of 5 to 15 years. On multivariate regression analysis age, height, weight, and BSA made significant contribution to the predictions in both genders The presented equations are nonlinear, and we considered these as superior to the linear equations published earlier.[8] In India, several studies were carried out on school children to predict the lung functions using anthropometric variables.[3,10,11] Significant correlation has been previously reported for PEFR with height, weight, age, socioeconomic conditions, chest circumference, and BSA.[6] In the present study significant correlation was found between PEFR with age, height, weight, and BSA as in other studies as well. It was also observed that all anthropometric parameters were higher in males than in female group for the corresponding age in the present study. A gender difference in airway behavior over human life span has been observed by Becklake and Kauffmann.[12] The present study compared favorably with Gaur et al.[13]

Prediction equations of PEFR for both sexes to predict PEFR using weight, age, BSA for urban children of Lucknow in the studied age group are limited.[14,15] It is a well-known fact that lung function parameters vary considerably between different regional and ethnic groups, residing within the same country.[5] Therefore, ideally speaking, all the Indian states and geographical regions as well as communities must have their own separate norms for these parameters.

There have been limited studies on PEFR in Lucknow. Srivastava et al in 90's studied lung functions in 8-13 yrs old children and changes occurring in their values with various respiratory disorders. We have taken up the study only in healthy children.[16]

PEFR values of Indian children have been found to be lower than western children. It could be an effect of lower lung volumes due to a smaller chest size as has been reported previously in adults.[14] Prasad et al drafted a prediction model for PEFR for north Indian population. This was carried out in healthy subjects, similar to our study population but age group was not comparable as it was done in 10-60 yrs age.[17] A study from Punjab north India derived regression equation for PEFR in healthy children, but sample size was small and regionally too the anthropometric parameters of Punjabi children are not predictable for our region.[5] Sharma et al from Ajmer, Rajasthan also evaluated PEFR in school going children but from a rural background.[18] Because of the variation in PEFR regionally and ethnically as well, PEFR values have been compared in north and south Indian populations.

The present study has important clinical information for pediatricians measuring PEFR in clinics. As interpretation of PEFR data requires a comparison with predicted values in normal population, selection of the correct prediction equations is an important step. The software of computerized spirometers that are used in India usually do not provide any Indian, equations for other populations, usually Caucasian are used.[3,19] Since Caucasian and Indian predictions of normal values differ substantially, using them may lead to substantial errors and thus adversely affect management decisions.[20]

Hence it would be very appropriate to use our prediction equations.

The present study thus addresses an unmet need in PEFR testing in Indian children in clinical studies by providing prediction equations that are appropriate for the local population.

The limitation of this study was that we restricted our inclusion to northern Indian children. They may not be applicable to other regions of India due to the possibility of anthropometric differences owing to racial diversity of India.

We have presented prediction equations for spirometry parameters for children of north Indian origin using the current standardized methodology. These equations address a need for appropriate evaluation of PEFR in clinical and research studies.

CONCLUSION

We developed prediction equations of PEFR for children using weight, height, and body surface area using standard methodology. This would be greatly helpful in evaluation of children with airway diseases.

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REFERENCES

1. Manjunath CB, Kotinatot SC, Babu M. Peak Expiratory Flow Rate In Healthy Rural School Going Children (5-16 Years) of Bellur Region For Construction of Nomogram. J Clin Diagn Res. 2013;7(12):2844–6.
2. Chhabra SK, Kumar R, Mittal V. Prediction Equations for Spirometry for Children from Northern India. Indian Pediatr. 2016;53:781-5.
3. Raju PS, Prasad KV, Ramana YV, Ahmed SK, Murthy KJ. Study on Lung Function Tests and Prediction Equations in Indian Male Children. Indian Pediatr. 2003;40:705-11.
4. Ranu H, Wilde M, Madden B. Pulmonary Function Tests. Ulster Med J. 2011;80(2):84–90.

5. Mittal S, Gupta S,Kumar A, Singh KD. Regression equations for peak expiratory flow in healthy children aged 7 to 14 years from Punjab, India. Lung India. 2013;30(3):183–6.
6. Pulickal AS, Fernandez GV. Peak expiratory flow rate in healthy rural south Indian school children predicted from body height. Indian J Public Health. 2007;51(2):117-9.
7. Chhabra SK. Interpretation of spirometry: Selection of predicted values and defining abnormality. Indian J Chest Dis Allied Sci. 2014;57:91-105.
8. Dickman ML, Schmidt CD, Gardner RM. Spirometric standards for normal children and adolescents (ages 5 years through 18 years). Am Rev Respir Dis. 1971;104:680-7.
9. Sherill DL, Camilli A, Lebowitz MD. On the temporal relationship between lung function and somatic growth. Am Rev Respir Dis. 1989;140:638-44.
10. Harikumaran NR, Kesavachandran C, Sanil R, Srikumar R, Shashidhar S. Prediction equation for lung functions in south Indian children. Indian J Physiol Pharmacol. 1997;41:390- 6.
11. Jain SK, Ramaiah TJ. Lung volumes and mechanics of breathing in healthy 7-14 years old. Indian J Chest Dis. 1968;10:63-8.
12. Becklake MR, Kauffmann F. Gender differences in airway behavior over the human life span. Thorax. 1999;54:1119–38.
13. Gaur N, Sharma M, Mittal S, Verma P, Singh S. Peak expiratory flow rate in adolescents of garhwal Region. J Adv Res Biol Sci. 2011;3(2):154-8.
14. Swaminathan S,Venkatesan P, Mukunthan R. Expiratory flow rate in south Indian children. Indian Pediatr. 1993;30(2):207-11.
15. Parmar V, Kumar L, Malik SK. Normal values of peak expiratory flow rate in healthy North Indian school children, 6-16 years of age. Indian Pediatr. 1977;14:591-4.
16. Srivastava A, Kapoor RK, Misra PK, Srivastava KL, Thakur S, Shukla N. Pulmonary function tests in normal Indian children and changes in respiratory disorders. Indian Pediatr. 1995;32(6):629-34.
17. Prasad R, Verma SK, Agrawal GG, Mathur N. Prediction Model for Peak Expiratory Flow in North Indian Population. Indian J Chest Dis Allied Sci. 2006;48:103-6.
18. Sharma R, Jain A, Arya A, Chowdhary BR. Peak Expiratory Flow Rate of School Going Rural Children Aged 5-14 Years from Ajmer District, Indian Pediatr. 2002;39:75-8.
19. Chatterjee S, Mandal A. Pulmonary function studies in healthy school boys of West Bengal. Jpn J Physiol. 1991;41:797-808.
20. Aggarwal AN, Gupta D, Behera D, Jindal SK. Applicability of commonly used Caucasian prediction equations for spirometry interpretation in India. Indian J Med Res. 2005;122:153-64.

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