e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2022; 14 (12); 709-716

Original Research Article

Anthropometric Parameters as Predictors of Peak Expiratory Flow Rate in Primary School Children

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Received: 01-11-2022 / Revised: 15-11-2022 / Accepted: 25-11-2022
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Conflict of interest: Nil

Abstract:

Background: Children suffering from bronchial asthma have fall in the PEFR is one of the earliest signs of impending acute asthma attack. Serial PEFR measurements enables to determine response to treatment and to follow progression of the disease.

Aim and Objectives: To find whether the anthropometric measurements are predictors of Peak Expiratory Flow Rate in Primary school children.

Materials and Method: A Cross sectional study conducted on 867 among primary school children between 6 years to 12 Years, from RHTC Annaram of Karimnagar District, for the period of one year during July 2019 to June 2020, after fulfilling inclusion and exclusion criteria and after getting consent from patients.

Results: Out of 867 patients females in the age group 9-12 years were in high number i.e., 269 (31%), mean age group of the study subjects in the present study was 9.05 + 2.026 years, The mean PEFR in the age group of 6-8 years and 9-12 years was 142.60 + 27.31 and 233.91 + 37.16 respectively. Mean PEFR among male and female gender was 199.75 + 57.127 and 191.21 + 54.86 respectively. Among males, the highest correlation was found between PEFR and height (r – 0.871), followed by BSA and PEFR (R – 0.860), weight and PEFR (R – 0.843), CC and PEFR(r – 0.798). Among females, the highest correlation was found between PEFR and height (r – 0.870), followed by weight and PEFR (R – 0.831), CC and PEFR (r – 0.826), BSA and PEFR (R= -0.095).

Conclusion: As interpretation of PEFR data requires a comparison with predicted values in normal population, selection of the correct prediction equations is a crucial step.

Keywords: Bronchial Asthma, PEFR, BSA

Introduction

Obstructive airway diseases prevalence is on a rise in children worldwide. Among them, Bronchial asthma is a common illness affecting all levels of society and a potentially serious chronic inflammatory disorder that imposes a substantial burden on patients, their families and the community. It causes respiratory symptoms, activity limitation and flare-ups that sometimes require immediate medical

attention and health care which may be fatal [1]. Children suffering from bronchial asthma havefall in the PEFR is one of the earliest signsof impending acute asthma attack. Serial PEFR measurements enables to determine response to treatment and to follow progression of the disease [2].

Pulmonary function tests are important tools for physiologic study to clinical investigation in assessing respiratory status. The development of pulmonary function and growth of physical parameters are concurrent in children [3]. Hence, measurements of lung function are equally essential for the evaluation of physical development and complete assessment of children and adolescent with respiratory disease.

PEFR remains as a valuable indicator of pulmonary function, even in the time of advanced computerized pulmonary function testing has made their advent. It provides a simple quantitative and reproducible measure of resistance and airway obstruction severity [4]. However, a more reliable test, like Spirometer is required to confirm or exclude airflow limitation due to substantial testing variability [5]. By virtue of simplicity of PEFR measurement and its positive correlation with Spiro matric parameters such as FVC and FEV1, it is beneficial in the assessment of respiratory function particularly in children who may not be able to follow instructions required for Spiro matric measurements [6].

PEFR is the flow rate that a person can exhale during a maximal expiratory effort after a full inspiration [5]. It is chiefly influenced by efficiency of expiratory muscles, elastic recoil pressure of lung and airway size. These factors have geographic, genetic, ethnic, racial, socio-economic, lifestyle, technical factors and anthropometric variations. Likewise, nutrition in young age affects the body proportions which may directly affect the size of lungs [7].

PEFR can be measured with the help of an instrument called as peak flow meter. It is a handy, portable and compact device that has graduations in litres / minute. It is also a simple, low cost, reliable way of monitoring PEFR in children with bronchial asthma during clinical visits and also at home. [8] PEFR is used in this study to predict about its variations with anthropometric determinants.

As the predictive normal values for PEFR correlates well with height, this study aims to derive normative standard for PEFR and to elucidate the correlation of PEFR values with age, sex, height, weight, chest circumference, Body surface area and body mass index in primary school children aged 6-12 years. This will be useful when dealing with asthmatic children, as their PEFR measurement can be easily compared with the normal predictive values for different age, sex and anthropometric parameters. As, India being a subcontinent, pulmonary norms may vary according to different geographic locations and it is prerequisite to have normal pulmonary function data in native population to interpret accurately the pulmonary function changes in childhood pulmonary diseases. Moreover, the availability of a monogram and prediction equations in school going children will also help in school screening programs.

In the present study we are going to find whether the anthropometric measurements are predictors of Peak Expiratory Flow Rate in Primary school children

Materials & Methods

In this Cross sectional study conducted on 1031 among primary school children between 6 years to 12 Years, from 22 Elementary schools in Geesugonda covered under Warangal District (Rural), for the period of one year.

Sampling Procedure and Sample Size:

Sampling is done in the following steps:

There are two divisions in Warangal District (rural) i.e., Geesugonda (9 Mandal's) and Narsampet (6 Mandal's). By lottery method we have selected Geesugonda division for our study. There were total 22 Elementary schools in Geesugonda covered under Warangal District (Rural). All the children meeting the selection criteria were included in the study. The List of schools is obtained from the District Educational Officer.

Sample Size: All the school children of the 22 schools and whose parents/guardians willing to allow their children to participate in the study were selected for the study. {Total school children = 1031 (Boys=521, Girls=510)}.

867 students were included in this study who fulfilled the selection criteria.

Inclusion Criteria:

- Apparently healthy school going children in the age group of 6-12 years.
- Children who attend the school on the day of study.

Exclusion Criteria

- Children those are absent in the class during the study period.
- Children and parents who are not willing to participate in the study.
- Any respiratory illnesses
- Any infection or illnesses that cause generalised malaise or fatigue such that their ability or willingness to cooperate with the study process is compromised
- Systemic disease like cardiac or renal problems
- Clinically significant anaemia
- H/o any drug intake which can affect PFT
- H/o any allergy
- Children with bone deformity of chest or spine and any muscular weakness
- Family history of atopic, asthma or other chronic lung diseases

Methodology:

Description of Peak flow meter:

The instrument used for measuring peak expiratory flow rate in children is a mini-Wright peak flow meter made in England (Clement Clarke). It consists of a cylindrical body and cylindrical mouth piece. The cylindrical body has a spring piston that slide freely on the red within the body of the instrument. When the child blows through the mouth piece the piston is pushed forward and it drives and independent sliding indicator (pointer). Along the slot marked with a scale graduated 60- 800L/min. the indicator records the maximum movement of the piston and remains in that position until return to zero by the operator. The mouth piece was detachable. The instrument was cleaned with regularly during use. In use, the instrument is to be held horizontally.

Statistical tools: Data entry was done using M.S. Excel and it will be statistically analysed using Statistical package for social sciences (SPSS Version 21) for M.S Windows. Descriptive statistics of the explanatory and outcome variables was calculated by mean, standard deviation for quantitative variables, frequency and proportions for qualitative variables. Inferential statistics like Chi square test was applied to test the association between quantitative variables and unpaired sample test was applied to check the statistical difference between quantitative variables. Pearson correlation was used to test the correlation between two quantitative variables. Linear regression was applied to predict the equation between multiple variables. P-value less than 0.05 considered to be statistically significant.

Observations and Results

During study period, a total of 867 school children was recruited. It was a Descriptive Cross-sectional study to assess the PEFR values among apparently normal children aged 6 to 12 years and to study the correlation of PEFR with anthropometric

determinants such as height, weight, chest circumference, body surface area and body mass index

Table 1 : Distribution of PEFR (L/min) and Anthropometric parameter.

Parameters	Mean	Std. Deviation	Minimum	Maximum
AGE (years)	9.05	2.026	6	12
HEIGHT (cm)	125.14	14.1717	100	163
WEIGHT (kg)	27.469	7.9135	15.5	53.2
BMI (kg/m2)	17.939	11.4354	14.1	184
BSA (m2)	1.2383	4.53023	0.16	78
CC (cm)	63.486	7.8043	49.5	82.5
1ST PEFR VALUES	181.67	56.322	18	350
2ND PEFR VALUES	185.76	57.557	100	350
3RD PEFR VALUES	191.58	56.226	100	348
BEST PEFR VALUE	195.37	56.107	110	350

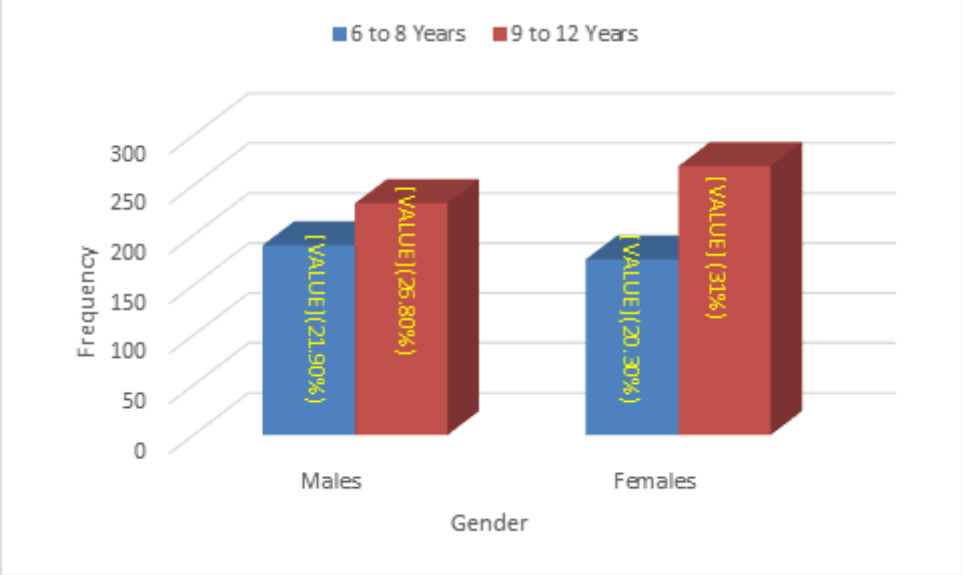

Figure 1: Age and sex wise distribution of the study subjects

Chi-Square: 2.66, P Value: 0.05, Statistically Significant

In the present study, females in the age group 9-12 years were in high number i.e., 269 (31%), followed by males in the age group of 9-12 years (26.8%). In the age group of 6-8 years, males (21.9%) outnumbered females (20.3%). There was a significant association found between age and gender. (p – 0.05). The mean age group of the study subjects in the present study was 9.05 + 2.026 years, with a range of 6-12 years.

Table 2: Mean PEFR values with respect to Age, Gender and BMI

	N	Mean	Std. Deviation	T Test	P Value
Age					
6 to 8 Years	366	142.6	27.312	-39.8	0.001**
9 to 12 Years	501	233.91	37.166		
Gender					
Males	422	199.75	57.127	2.24	0.025*
Females	445	191.21	54.863		
BMI					
<18.5	666	185.06	55.004	-10.43	0.001**
18.6-24.9	201	229.5	45.243		

**Highly Significant at 5% level of significance and *Significant at 5%

The mean PEFR in the age group of 6-8 years and 9-12 years was 142.60 + 27.31 and 233.91 + 37.16 respectively. T test showed that there was significant difference between age groups and the mean PEFR values (p – 0.001).The PEFR showed gradual increase with advancing age.

The mean PEFR among male and female gender was 199.75 + 57.127 and 191.21 + 54.86 respectively. T test showed that there was a significant difference between gender and the mean PEFR values (p : 0.025). PEFR was only marginally higher in boys when compared with girls.

The mean PEFR among the study subjects with BMI < 18.5 and 18.5 – 24.9 was 185.06 + 55.004 and 229.50 + 45.24 respectively. There was significant difference found between BMI and mean PEFR values. (p – 0.001). PEFR values rises as BMI increases in both genders.

All the anthropometric measurements were found to be positively correlated with PEFR in both gender. There was significant association found between PEFR and the anthropometric measurements. (P < 0.001)

Among males, the highest correlation was found between PEFR and height (r – 0.871), followed by BSA and PEFR (R – 0.860), weight and PEFR (R – 0.843), CC and PEFR(r – 0.798).

Among females, the highest correlation was found between PEFR and height (r – 0.870), followed by weight and PEFR (R – 0.831), CC and PEFR (r – 0.826), BSA and PEFR (R= -0.095).

In general, the descending order of correlation was found between PEFR and height(r - 0.865), weight (r – 0.830), CC (r – 0.807), BMI (r – 0.119) and BSA (r = -0.053).

The above table describes the predictive equations for predicting PEFR – simple regression equation constructed separately for boys and girls based on height, weight, BMI, BSA, CC and age.

Interpretation

Height: For a unit increase in height, PEFR for males increases by 3.603 units and 3.288 units for females.

Weight: For a unit increase in weight, PEFR increases by 6.576 units for males and 5.401 units for females.

Table 4: Correlation between PEFR and anthropometric measurements with respect to gender.

S. No.	Male	Female	Total
Height	PEFR=3.603 (Ht)-249.9	PEFR=3.288(Ht)-221.23	PEFR=3.425(Ht)-233.2
	r= 0.871 (P Value: 0.001)	r= 0.87 (P Value: 0.001)	r= 0.865 (P Value: 0.001)
	R2 =0.758 (P Value: 0.001)	R^2=0.757(P Value: 0.001)	R^2=0.748(P Value: 0.001)
Weight	PEFR=6.576 (Wt)+19.70	PEFR=5.401 (Wt)+42.38	PEFR=5.884(Wt)+33.73
	r= 0.843 (P Value: 0.001)	r= 0.831 (P Value: 0.001)	r= 0.83 (P Value: 0.001)
	R2=0.711(P Value: 0.001)	R^2=0.690(P Value: 0.001)	R^2=0.689(P Value: 0.001)
BMI	PEFR= 10.46(BMI)+18.84	PEFR=10.50(BMI)-18.79	PEFR=10.58 (BMI)+18.89
	r= 0.299(p-value :0.001)	r= 0.147 (P-value:0.002)	r= 0.119(P-value : 0.001)
	R2=0.09(P Value: 0.001)	R^2=0.02(P Value: 0.002)	R^2=0.014(P Value: 0.001)
BSA	PEFR=266.30 (BSA)-59.38	PEFR=203.7(BSA)-9.43	PEFR= 228.66 (BSA)-29.18
	r= 0.86(p-value : 0.001)	r= 0.095 (P-value:0.045)	r= 0.053(P-value : 0.11)
	R2=0.740(P Value: 0.001)	R^2=0.009(P Value: 0.045)	R^2=0.003(P Value: 0.116)
CC	PEFR=6.22(CC)-194.49	PEFR=5.50(CC)-158.7	PEFR= 5.798 (CC)-172.74
	r= 0.798(p-value :0.001)	r= 0.826 (P-value:0.001)	r= 0.807(P-value : 0.001)
	R2=0.637(P Value: 0.001)	R^2=0.682(P Value: 0.001)	R^2=0.651(P Value: 0.001)
Age	PEFR =25.31 (Age)-26.95	PEFR=23.45 (Age)-23.31	PEFR=24.19 (Age)-23.68
	R^2=0.793(P Value: 0.001)	R^2=0.760(P Value: 0.001)	R^2=0.763(P Value: 0.001)

P < 0.05 is considered significant.

Interpretation

BMI: For a unit increases in BMI, PEFR increases by 10.46 units for males and 10.50 units for females

BSA: For a unit increase in BSA, PEFR increases by 266.3 units for males and 203.7 units for females.

CC: for a unit increase in CC, PEFR increases by 6.22 units for males and 5.50 units for females.

Age: For a unit increase in age, PEFR for males increases by 25.31 units and for females by 24.19 units.

Table 5: Multiple regression equation for predicting PEFR

Gender	Predicted Equations	R-Square	P-Value
Boys	PEFR =110.343 + (15.445×Age in years)* + (1.129× Height in cm)* – (1.015 ×Weight in Kg)+ (117.92 × BSA in m2) – (0.88× CC in cm)	0.849	0.001
Girls	PEFR = 211.84+ (13.76×Age in years)* + (2.506×Height in cm)* – (1.373× Weight in Kg)* –(0.374×BSA in m2)+(0.019×CC in cm)	0.854	0.001

P-value <0.05 is Significant

As the correlation was robust with age, height, weight, BSA and CC, multiple regression equations were constructed separately for boys and girls using these variables.

Discussion

The peak flow meter has been used in the clinical practice and in the epidemiological surveys for estimating ventilatory capacity and had proved to be practical aid in the investigation of chest diseases. PEFR plays a very important role in home monitoring of asthmatics. It also has a significant role in daily monitoring, daily variations, effectiveness of current therapy and the need for any additional treatment.

Dugdale AE et al [9], observed the PEFR measurement gives an indicator of airway calibre of respiratory system and regulatory

function of respiration which sometimes is affected by certain progressive neurological disease.

PEFR monitoring is found out to be equivalent to symptom-based asthma plans according to recent meta-analysis. As airflow limitation is detected objectively if PEFR is less than 80% of the reference value, PEFR estimation becomes clinically helpful only if it is compared with normative data. PEFR is known to differ considerably between different regional and ethnic groups, residing within same country. Hence, it is essential to have regional reference values for appropriate assessment and diagnosis. This study was aimed to derive normative standard of PEFR in the apparently normal school children aged 6-12 years residing in Geesugonda division of Warangal District and to calculate prediction equation as well as to elucidate the correlation of PEFR with anthropometric parameters.

The present study revealed that mean PEFR in the age group of 6-8 years and 9-12 years was 142.60 ± 27.31 years and 233.91 ± 37.16 years respectively. There was significant difference between age groups and the mean PEFR values. It increased in linear relation to age. Age was a significant factor with positive correlation for predicting PEFR in studies that were conducted by Sachin Pawar ET al7 (2014) and Abraham B ET al [5] (2014).

The mean PEFR among male and female gender was 199.75 ± 57.127 and 191.21 ± 54.86 respectively. Mean PEFR values of boys were marginally higher than that of girls but there was no significant difference between gender and the mean PEFR values in the present study.

Our finding was in accordance with the studies conducted by Pagadpally Srinivas [10] (2013) and Abraham ET al [5] (2014), where PEFR was marginally higher in boys than girls with no statistical significance. But in studies conducted by Srivastava S ET al [11] (2017) observed significant mean difference of PEFR between boys and Girls. [12]

Results of the present study showed that all the anthropometric measurements were found to be positively correlated with PEFR in both gender. Among males, the highest correlation was found between PEFR and height (r – 0.871), followed by BSA and PEFR (R – 0.860), weight and PEFR (R – 0.843), CC and PEFR(r – 0.798). Among females, the highest correlation was found between PEFR and height (r – 0.870), followed by weight and PEFR (R – 0.831), CC and PEFR (r – 0.826), BSA and PEFR (R= -0.095). In general, the descending order of correlation was found between PEFR and height (r - 0.865), weight (r – 0.830), CC (r – 0.807), BMI (r – 0.119) and BSA (r = -0.053).

Similarities was noticed in respect to the results from the study handled by Pagadpally Srinivas[12] (2013) and Jomon Mathew John (2018) which showed good correlation of PEFR with Height, Chest circumference, Weight and BMI in the descending order. But BSA was not considered as an anthropometric attribute in those two studies.

Abraham B ET al[5] (2014) exhibited that PEFR has strong positive correlation with height, weight, mid upper arm circumference and chest circumference, but it has poor correlation with BMI. Mid upper arm circumference was not included in our study, because though mid upper arm circumference is an indicator of malnutrition, but this measurement is not significant for the children aged above 5 years

The present study has valuable clinical importance for paediatricians measuring PEFR in day to day practices in evaluation of children with airway diseases. As interpretation of PEFR data requires a comparison with predicted values in normal population, selection of the correct prediction equations is a crucial step.

Acknowledgement : None

Funding : None

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