Vol 45 (3) September , 2021

Print: ISSN 0304 4904
Online: ISSN 2305-820X

PAKISTAN PEDIATRIC JOURNAL

A JOURNAL OF PAKISTAN PEDIATRIC ASSOCIATION

Indexed in EMBASE/Excerpta Medica, Index Medicus WHO
IMEMR & Global Health/CAB Abstracts and UDL-EDGE Products and Services

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ORIGINAL ARTICLE

Assessment of Peak Expiratory Flow Rate in Association with Gender and Anthropometric Measurements in School Children

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Pak Pediatr J 2021; **45(3):** 260-64

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Received 14th September 2020;
Accepted for publication
18th May 2021

ABSTRACT

Objective: This study aimed to evaluate gender and anthropometry related differences in peak expiratory flow rate (PEFR) for the children of Maharashtra, India.

Study Design: Cross-sectional study.

Place and Duration of Study: In 107 schools of Kolhapur district; between August 2018-July 2019.

Material and Method: The study was conducted among 1200 healthy school children (10-16 years) with equal gender distribution. Anthropometric parameters and PEFR were measured. Height and weight of male/female children were represented using frequency distribution. Mann-Whitney-U Test, Spearman-Rank-Correlation and Simple linear regression was used to find the relationship between the variables ($p<0.05$).

Results: Mean PEFR values of males and females were 362.17 ± 89.88 l/min & 351.35 ± 79.85 l/min respectively. Difference was not found to be statistically significant ($p=0.1503$). In both males and females, PEFR positively correlated with height ($r=0.91$; $r=0.87$) and weight ($r=0.79$; $r=0.75$) respectively. A feasible regression equation was derived to predict PEFR for children.

Conclusion: PEFR values showed gender related variability although not statistically significant. The derived regression equation can be used for PEFR prediction in male and female school children.

Key Words: *Anthropometry, Gender, Peak expiratory flow rate, School children*

INTRODUCTION

Respiratory illnesses are a significant cause of mortality and morbidity in children of both developed and developing countries.[1] World-wide, the prevalence of obstructive airway diseases like asthma ranges from 1% to 18%.[2] In India, the estimated prevalence of asthma is nearly7.4% in children aged 10-16 years.[3]

It has been observed that in early stages of life, gender related susceptibility to inflammatory processes is present. It points towards the inverse association between C-reactive protein (CRP - a sensitive marker of systemic inflammation) and lung capacity; which means with increase in CRP levels, there will be a decline in lung function; and this inverse association is characteristic of males.[4] Other causes for gender related differences in

peak expiratory flow rate (PEFR) are associated with anatomic factors, sex hormones, genetics and airway microbiology.[5]

PEFR is an effort-dependent measurement which remains at the peak for 10 msec.[6] It can be measured easily with portable instruments with the added advantage of detection of inflammatory changes in bronchi even in asymptomatic states.[7,8] It is well established from various literature that PEFR is affected by gender-related differences and anthropometry.[9,10] Therefore, it is essential to establish gender specific regression equations in order to obtain reference values. Furthermore, the results obtained from PEFR assessments are interpretable only by the "reference values" of the population to which the individual belongs.

Hence, the aim of the study was to determine PEFR values pertaining to gender, additionally to assess the correlation of PEFR with anthropometry and to derive prediction formula for PEFR for the children of Maharashtra, India.

MATERIAL AND METHODS

The cross-sectional study was conducted among healthy school going children in the age range of 10-16 years (n=1200), between August 2018-July 2019. Prior permission was obtained from the Institutional Ethics Committee (DMCK/151/2018, 14/05/2018) and local school authorities. The purpose of the study was explained to all parents and students of higher classes. Healthy students were selected from 107 schools of Kolhapur district by stratified random sampling. Written informed assent/consent was obtained from the parents. Children with a history of acute respiratory infections within 14 days of the study, past-history or family history of asthma, allergies, chest injuries, malnutrition (according to Indian Academy of Pediatrics standard criteria) and not belonging to the desired age group were excluded.[11] Sample size was calculated by using library (pwr) package. Values for pwr. t test (d = 0.1, power = 0.92, significance level = 0.05, type ="one-sample proportion test"). Minimum sample size calculated was 1134.

A structured proforma was used to collect demographic data and clinical history. Anthropometric measurements (height and weight) were measured. Height was measured by a fixed calibrated stadiometer and the child was instructed to remove his/ her footwear; with the children standing erect, looking forward with their heels and back against the anthropometric rod. Measured height was corrected to the nearest centimeter. Weight was measured in kilograms (kg) using a standard digital weighing machine and was calibrated before measuring. Weight was measured with school uniform but without footwear. The weighing machine was kept on a flat surface and the child was instructed to stand on the center of the platform.[12] PEFR was measured using a EU scale peak flow meter (Peak Flow Master Breathe-O-Meter; CIPLA: 60-800 l/min, India) in a similar manner as described by Ullah et al[13] PEFR was measured thrice for each student and the mean value was noted in the proforma. Measurement of flow rate was carried out by a single observer to eliminate the inter observer variation.

Data was analyzed using R software version 3.6.1. Height, and weight of male/female children were represented using frequency distribution. Mean difference was found between PEFR values of males and females by using Mann-Whitney-U Test. Spearman-Rank-Correlation was used to find correlation between PEFR values and height, weight of male/female students, respectively. Simple linear regression was used for estimating PEFR equation based on height & weight of male/female children. P value less than 0.05 was considered significant.

RESULTS

Of the total participants (n=1200), equal gender distribution was observed among the students (n=600); with age range of 10-16 years. Among the male and female children, most of the participants belonged to height range of 131 – 140 cm, (n=195 and n=213), respectively. Most of the participants among males (n=354), and females (n=262), weighed 31 – 40 kg, respectively (table 1).

Mean PEFR values of male and female children, were 362.17 ± 89.88 l/min and 351.35 ± 79.85 l/min respectively. No significant mean difference was observed in PEFR values of both genders at 5% significance level (p=0.1503).

In males, height and weight positively correlated with PEFR (r=0.91; r=0.79 respectively). Similarly, in females height and weight positively correlated with PEFR (r=0.87; r=0.75 respectively) table 2.

TABLE 1: Distribution of variables in relation to gender (n=1200)

Variables	Male (n=600)	Female (n=600)
Height (cm)		
111 - 120	2	11
121 – 130	153	150
131 - 140	195	213
141 - 150	120	137
151 - 160	93	62
161 - 170	37	27
Weight (kg)		
21 – 30	98	164
31 – 40	354	262
41 – 50	138	146
51 - 60	10	28

TABLE 2: Statistical correlation of variables with PEFR

Gender	Variables	Correlation¥	p-value
Male	Height	0.91	$2.20e^{-16*}$
	Weight	0.79	$2.20e^{-16*}$
Female	Height	0.87	$2.20e^{-16*}$
	Weight	0.75	$2.20e^{-16*}$

¥Spearman Rank Correlation, *Significant

On comparing male vs female, height and weight of male students alone explained 81.35% and 60.12% of variability in PEFR (table 3).

TABLE 3: Regression analysis for estimating PEFR values

Variable	Gender	Regression equation	R^2
Height	Male	PEFR= -611.56+6.95* Height	0.8135
	Female	PEFR= -506.32+6.2* Height	0.6828
Weight	Male	PEFR=27.03+9.03* Weight	0.6012
	Female	PEFR=8.57+9.41* Weight	0.5501

DISCUSSION

PEFR is a reliable and early way of detection of inflammatory changes in the bronchi even in asymptomatic states.[14] It has been observed that lung function measurements are influenced by gender-related differences and anthropometry.[15,16] Hence, the aim of the study was to determine PEFR values pertaining to different genders and to assess the correlation of PEFR with anthropometry among male and female children of Maharashtra, India.

In contrast to findings of other studies conducted in different regions of Maharashtra, participants belonged to height range 131 – 140 cm irrespective of their genders.[17] It is inferable that height is an important marker of variation in biological deprivation, cumulative net nutrition, and living standards between populations and within the same population and must be routinely measured.[18] This points towards the lack of proper nutrition which in turn affects lung health and leads to reduction of the strength of ventilatory muscles; hence affects the lung functions.[19]

Children weighed 31 – 40 kg irrespective of their gender. Similar finding was observed in previous literature.[17] Importance of body weight measurement can be ascribed to interrelationship between childhood obesity and increased airway resistance. Excess fat deposition leads to respiratory muscle dysfunction which in turn affects peak expiratory flow rate and thus it helps in diagnosing respiratory illness in obese individuals.[20]

Mean PEFR values of male children were more as compared to their female counterpart. Similar findings were seen in other studies.[21,22] It can be ascribed to differences in lung growth, variation in recoil pressure, variations in the shape of the lung and luminal areas of the airway being 14 – 31% larger in males. In addition to that, females have smaller rib cage size and length of the diaphragm is 9% shorter than males.[16] But still mean differences in PEFR values of both genders were statistically not significant (p=0.1503). This finding can be explained statistically; as not much difference is there in the mean values of PEFR of both the genders, hence, statistically no significance was found between PEFR values of both the genders.

Height and weight shows positive correlation with PEFR in both the genders similar to findings of previous researches.[17,22] On comparing height vs

weight irrespective of genders, it has been observed that height has maximal correlation with PEFR, similar to other studies.[9,23] It can be inferred that height is one of the main physiological determinants of the static lung volumes/ capacities.[24]

In contrast to findings of previous study, height and weight of male students alone explained 81.35% and 60.12% of variability in PEFR.[25] This difference in the findings can be explained by the difference in age groups.

The regression equation derived assessed PEFR based on the anthropometry such as height and weight of male/female children. The equations derived in the study contrasted with previous data available in the region.[22] This difference in the findings can be attributed to larger sample size of the present study which is more representative of the population.

Limitations of the study: Age groups and residential area were not determined and considered for PEFR prediction. Other limitations can be ethnicity and sample size. Further, the similar studies taking the above limitations into consideration can help in better prediction of PEFR.

CONCLUSION

PEFR values showed gender related variability but difference in the values was not found to be significant.

Anthropometric variables like height and weight has shown positive correlation with PEFR of male and female school children. Among the anthropometric variables, height is an important marker to assess nutritional status and standard of living. It can be a reliable measurement in field studies for assessing PEFR.

The regression equations obtained finds value in calculating the PEFR of the school children of the population which will facilitate in calculating the reference ranges.

Grant support and financial disclosures: Nothing to disclose.

Conflict of interest: None

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