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Correlation of PEFR with age and BMI in children of 10-15 years of age

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Abstract

Background: Respiratory diseases represent the most important cause of morbidity/ mortality in children. In this a large number accounts to be obstructive airway disease. Allergic respiratory disorders particularly asthma are increasing in prevalence.

Objectives: To study the correlation of age and BMI with peak expiratory flow rate in children aged 10-15 years.

Methods: A total of 200 children were included. All tests were carried out with prior permission from the head of the schools and informed consent from children's parents in local language. For each child detailed history and physical examination was done and all anthropometric parameters were measured and entered as per the proforma.

Results: Around 54% of the children were Male and 46% of them were female. Majority of the children 24.5% were 13yrs, followed by 20.5% were 12yrs, 18.5% were 11yrs, 14.5% were 14yrs, 12.5% were 10yrs and only 9.5% were 15yrs. There was a positive correlation between PEFR and BMI with r value 0.471 and this correlation was statistically significant. PEFR and female BMI had more positive correlation than Male BMI.

Conclusion: Maintenance of normal BMI in children and adolescents in order to prevent future risk of obstructive respiratory diseases. Prevention of malnutrition by dietary counselling, school health programmes, early detection of malnutrition by regular growth monitoring, health supplements and Obesity prevention by regular exercises and appropriate diet is important in maintaining normal PEFR.

Keywords: BMI, respiratory distress, asthma, malnutrition

Introduction

Respiratory diseases represent the most important cause of morbidity/ mortality in children. In this a large number accounts to be obstructive airway disease. Allergic respiratory disorders particularly asthma are increasing in prevalence. Asthma is a chronic inflammatory condition of the lung airways resulting in episodic airflow obstruction. This chronic inflammation heightens the twitchiness of the airways—airways hyperresponsiveness (AHR)—to provocative exposures. Pulmonary function tests of various types are utilized clinically as well as epidemiologically to measure functional status of respiratory system [1].

Pulmonary function testing, although rarely resulting in a diagnosis, is helpful in defining the type of process (obstruction, restriction) and the degree of functional impairment, in following the course and treatment of disease, and in estimating the prognosis. It is also useful in preoperative evaluation and in conformation of functional impairment in patients having subjective complaints but a normal physical examination. In most patients with obstructive disease, a repeat test after administering a bronchodilator is warranted [2]. The peak expiratory flow rate (PEFR) measurement is simple, reproducible and reliable way of judging the degree of airway obstruction in various obstructive pulmonary diseases, especially asthma. PEFR usually varies according to many independent variables including gender, age, weight, height and chest circumference; its variability due to age generally establishes different reference values for children [3].

PEFR measurement can reveal the diurnal variability of airway of patient suffering from reactive airway disease but not in normal children; that gives the early clue to have the diagnosis and management. Fall of peak expiratory flow rate in a child with asthma is impending sign of acute asthma. The response to treatment can be monitored by using serial PEFR measurement [4]. As for any parameter used to assess dysfunction, the importance of having regional reference value cannot be overlooked. Many studies have shown that pulmonary function values differ due to racial and ethnic differences.

Within India also, pulmonary function vary due to ethnic differences. Therefore, it is important to establish reference values for different regions of every country. In India, it is necessary to have region-specific study relating to PEFR and anthropometry in growing children, as the mosaic of Indian population is spread in a varied and complex geography [5]. By keeping in view the limitations of PEFR. This study aims to construct a normal PEFR value in both sexes in the age group of 10-15 years and its correlation with age and BMI in normal children in and around Moinabad Mandal, R.R district and for comparison with other studies carried out in and out of India.

Materials and Methods

Type of Study: A cross sectional study

Place of Study: Schools in and around Bhaskar General Hospital and Bhaskar medical college, Moinabad, Ranga Reddy district.

Study Duration: March 2019 to September 2019

Sample Size: The present study was conducted among 200nschool going children of 10-15 years of age.

Study Population: School going children in the age group of 10 to 15 years.

Inclusion criteria

School going children in the age group of 10 to 15 years.

Exclusion criteria

- Bronchial asthma.
- Acute or chronic respiratory tract infection (at least 3 months before examination).
- Acute or chronic cardiac disease.
- Any systemic illness.
- History of allergy.
- Structural deformity of the thoracic cage.
- Substance abuse (e.g.: smoking)

Methodology

All tests were carried out with prior permission from the head of the schools and informed consent from children's parents in local language. For each child detailed history and physical examination was done and all anthropometric parameters were measured and entered as per the proforma. Following examination, each child was subjected to measurement of peak expiratory flow rate according to the steps given below.

Before recording the procedure was demonstrated to each child. The following steps were followed with the wright's Mini Peak Flow Meter.

1. Set the cursor to zero. Do not touch the cursor when breathing out.
2. Stand up and hold the peak flow meter horizontally in front of the mouth.
3. Take a deep breath in and close the lips firmly around the mouth piece, making sure there is no air leak around the lips.
4. Breathe out as hard and as fast as possible.
5. Note the number indicated by the cursor.
6. Return the cursor to zero and repeat this sequence twice more, thus obtaining three readings.

The highest or best reading of all three measurements was the peak expiratory flow rate at that time.

Anthropometry

1. **Weight:** Child's weight was taken with minimal clothes using electronic scale.
2. **Height:** Height was measured using standard stadiometer.
3. **BMI:** With the obtained weight and height, BMI was calculated with the formula - wt. (kg)/ [ht (m)^2] and compared with IAP charts.

Ethics and Consent: Approval was taken from the Institutional Ethical Committee before commencing the study. The participants were informed regarding the purpose, procedures, risks and benefits of the study. Written and Informed Consent was obtained from all participants.

Statistical Analysis: Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean difference between two quantitative variables. ANOVA was used as test of significance to identify the mean difference between more than two quantitative variables. Correlations were performed with Pearson Correlation coefficient.

Observation and Results

Table 1: Distribution based on Gender and Age

Gender	Frequency	Percentage
Female	92	46.0
Male	108	54.0
Age (in yrs)		
10yrs.	25	12.5
11yrs	37	18.5
12 yrs.	41	20.5
13 yrs.	49	24.5
14 yrs.	29	14.5
15 yrs.	19	9.5
Total	200	100.0

Around 54% of the children were Male and 46% of them were female. Majority of the children 24.5% were 13yrs, followed by 20.5% were 12yrs, 18.5% were 11yrs, 14.5% were 14yrs, 12.5% were 10yrs and only 9.5% were 15yrs.

Table 2: Distribution of children according to Body Mass Index

BMI	Frequency	Percentage
Under Weight	24	12.0
Normal	150	75.0
Over Weight	19	9.5
Obese	7	3.5
Total	200	100.0

Majority of the children 75% had normal BMI, followed by 12% were underweight, 9.5% were overweight and only 3.5% were obese.

Table 4: Distribution of children according to PEFR

PEFR	Frequency	Percentage
200-249	28	14.0
250-280	52	26.0
281-310	34	17.0
311-340	42	21.0
341-370	28	14.0
371-400	16	8.0
Total	200	100.0

Majority of the children 26% had PEFR 250-280, followed by 21% had PEFR 311-340, 17% had PEFR 281-310, 14% had PEFR 341-370, 14% had PEFR 200-249 and only 8% had PEFR 371-400.

Table 5: Correlation of PEFR with Age, weight, height, BMI

Variable	r and p value	Male	Female	Overall
PEFR/age	Pearson Correlation (r value)	0.381**	0.468**	0.423**
	P value	<0.001	<0.001	<0.001
PEFR/weight	Pearson Correlation (r value)	0.610**	0.708**	0.652**
	P value	<0.001	<0.001	<0.001
PEFR/height	Pearson Correlation (r value)	0.543**	0.449**	0.509**
	P value	<0.001	<0.001	<0.001
PEFR/BMI	Pearson Correlation (r value)	0.442**	0.513**	0.471**
	P value	<0.001	<0.001	<0.001

There was a positive correlation between PEFR and age with r value 0.423 and this correlation was statistically significant. PEFR and Female age had more positive correlation than Male age. There was a positive correlation between PEFR and weight with r value 0.652 and this correlation was statistically significant. PEFR and Female weight had more positive correlation than Male weight.
There was a positive correlation between PEFR and Height with r value 0.509 and this correlation was statistically significant. PEFR and Male Height had more positive correlation than Female Height. There was a positive correlation between PEFR and BMI with r value 0.471 and this correlation was statistically significant. PEFR and female BMI had more positive correlation than Male BMI.

Discussion

PEFR varies accordingly to many independent variables including gender, age, weight, height and chest circumference; its variability due to age generally establishes different reference values for children. Pulmonary function vary due to ethnic differences. As for any parameter used to assess dysfunction, the importance of having regional reference value cannot be overlooked. Therefore, it is important to establish reference values for different regions of every country. In India, it is necessary to have region-specific study relating to PEFR and anthropometry in growing children, as the mosaic of Indian population is spread in a varied and complex geography.[6] In this study the correlation of age, sex, weight, height and BMI with PEFR was studied that may help in establishing reference standards for my study population.
Positive correlation of PEFR age in this study was in similarity with other studies. The growth of children occurs in phases during the childhood and adolescent periods. The PEFR readings which is dependent on musculoskeletal growth, nutrition and B.S.A increases progressively with age. In the present study mean PEFR was low in OBESE group compared to normal BMI group. This finding suggest deleterious effects of obesity on pulmonary functions. This findings are in concordance with many studies. So healthy life style activities, and regular exercises to maintain BMI improves respiratory functions and prevents the risk of asthma [7].
Mean PEFR was lowest in underweight children. Thus effective management of malnutrition by early diagnosis, education of parents, providing food supplements, mid-day meal programmes, effective treatment of infections and chronic conditions helps to prevent malnutrition thus maintaining healthy PEFR [8]. This reduction in lung functions and flow rates among undernourished children compared to their well-nourished counterparts had been attributed to possible muscle wasting and reduced strength of the ventilatory muscles. Diminished skeletal growth found among undernourished children may also contribute to their reduced lung capacities and flow rates.
In the obese patient, the tidal volume (TV) and FRC are decreased due to changes in elastic properties of the chest wall. Retractile forces of the lung parenchyma on the airways are reduced at low lung volume. At low FRC, the airway smooth muscle may be unloaded with a paradoxical increased shortness in response to normal parasympathetic tone or to other bronchial-constricting agents [9]. Thus, it has been hypothesized that in obese patients, breathing at low TV does not allow the normal stretching of airway smooth muscle during breathing, which causes the detachment of actin – myosin cross bridge of the airway smooth muscle. The bigger the TV, the greater the ensuing bronchial dilation [10]. This fact, known as “deep inhalation effect,” allows restoration of the dilation of the airways in normal conditions. This protective effect is reduced in obese individuals in comparison to lean subjects. Therefore, the net result of airway narrowing occurs in obese subjects [11, 12]. There was a positive correlation between PEFR and weight with r value 0.652 and this correlation was statistically significant. PEFR and Female weight had more positive correlation than Male weight. As the child grows heavier with age, there is increase in adiposity, muscle mass, development of skeletal framework and also increase in calibre of the large airways. The increase in PEFR with increase in weight can possibly be attributed to the rapid

growth of airway passages and expiratory muscle effort as height and weight increases, increase in weight can be due to increase in either musculoskeletal mass or fat deposition in adipose tissue. Hence the relationship of PEFR with weight need not necessarily be linear.

Advantages of the study

- The study helps to establish normal range of PEFR in children in and around Moinabad area.
- Factors influencing PEFR significantly were studied.
- In this study nutrition has a significant effect in achieving normal PEFR and pulmonary function. Early diagnosis and treatment of malnutrition is fundamental.
- In present study obesity also effects PEFR thus healthy life style and regular exercises is important in maintaining good pulmonary function.

Limitations of the study

- Small sample size.
- Diurnal variation of PEFR not been tested.
- Comparison of PEFR with spirometry for each child was not done.
- Long term follow up of these children was not possible owing to time shortage of time.

Conclusion

Findings of this study emphasise maintenance of normal BMI in children and adolescents in order to prevent future risk of obstructive respiratory diseases. Prevention of malnutrition by dietary counselling, school health programmes, early detection of malnutrition by regular growth monitoring, health supplements and Obesity prevention by regular exercises and appropriate diet is important in maintaining normal PEFR.

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