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Peak Expiratory Flow Rate in Normal School Children and Its Correlation with Height

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I. Introduction

During the past three decades, there has been an exponential increase in the number of physiological function tests designed to evaluate pulmonary function.These tests have made it possible to assess the functional abnormalities in persons with restrictive and obstructive airway disorders , with the availability of nomograms based on studies in normal healthy persons it is now possible to predict the range of normal lung function values in a given individual.The dominant functional abnormality in patients disabled by asthma,bronchitis,emphysema and other COPDs (Chronic Obtructive Pulmonary Disorders) is the difficulty in expiration.Hence the measurement of Peak Expiratory Flow Rate (PEFR) has gained world wide acceptability as a method for identification,assessment,rational therapy and followup of such patients.

PEFR is the greatest flow velocity that can be obtained during a forced expiration starting from fully inflated lungs. PEFR is influenced by various factors such as age,sex,height,weight,body surface area,environmental and ethnic differences.The measurement of PEFR is of value for the identification of chronic obstructive bronchitis and for assessment and follow up of patients with asthma.It is also very useful in the assessment of severity of airway obstruction.The Wright Peak Flow Meter, which was designed as simple and reliable device is used for measuring PEFR. This instrument has undergone many changes and reached its present form known as the miniature Wright Peak Flow Meter.For the purposes of evaluation of an observed reading of PEFR, a knowledge of its range in normal subjects of the same sex, age and body size is required.

II. Materials And Methods

1. Materials:

A. Selection of subjects :

The present study reports normal values for PEFR in 495 normal children from 5 – 18 years of age, measured using a miniature Wright Peak Flow Meter (MWPFM). These children constitute a representative cross section of normal school children. Students of both sexes were selected randomly from the primary,middle and high school (of R.G.M.School Sindhanur)

The following criteria were employed for acceptance as a Normal subject.

1. No history of cardiopulmonary disease.
2. No clinical evidence of cardiopulmonary disease.
3. No history or evidence of any other disease which could be expected to affect pulmonary function.
4. Capable of adequate co-operation.Children willing to participate with the consent of parent/guardian.

B. The Instrument:

Peak Flow Meter:

Background: The Peak flow meter was introduced in 1959 by B>M>Wright. This device became popular soon after, but was expensive, cumbersome & too sensitive for routine clinical use.However the concept of Peak flow rate caught on and efforts to develop a cheaper, simple and portable instrument to measure the same got under way. Thus was born in 1969, the miniature Wright Peak Flow Meter, commercial production of the same began in 1977.

The Mini Wright Peak Flow Meter:

The mini Wright peak flow meter operates on a spring loaded piston and a longitudinal slot as a variable orifice, which carries a rider or marker as Peak flow indicator. These are housed in a cylindrical plastic frame of dimension 5.0 cm diameter and 15 cms length. The instrument weighs 75 gms.

Operation And Use:

Air blown into mouth piece cannot escape until it has moved and uncovered part of the longitudinal slot. When the area of the slot uncovered is such that the pressure behind the piston is just enough to balance the tension in the spring, the piston comes to rest in a position that depends on the flow rate.

2. Methods:

The height of each child was measured without shoes. The purpose and technique of the test was described to the subjects in groups of ten and the method of blowing into the instrument was demonstrated. Each subject then held the instrument and had several trial blows, until it was clear that he/she was using the meter properly and comfortably (this usually required 2-4 blows). Each was encouraged to make a maximal effort and was closely watched to ensure that he/she maintained an airtight seal between the lips and mouth piece of the instrument. Each child blew five times into the flow meter and three maximum readings were recorded.

III. Observations/ Results

The children of 100-110 cms height group had a mean PEFR of 169.42 L/Min. with a S.D. of 21.43; the children of 111-120 cms height group had a mean PEFR of 206.79 L/Min. with a S.D. of 23.31; the children of 121-130 cms height group had a mean PEFR of 261.02 L/Min. with a S.D. of 23.34; the children of 131-140 cms height group had a mean PEFR of 304.40 L/Min with a S.D. of 39.3; the children of 141-150 cms height group had a mean PEFR of 349.40 L/Min. with a S.D. of 45.80; the children of 151-160 cms height group had a mean PEFR of 403.17 L/Min with a S.D. of 35.44; the children of 161-170 cms height group had a mean PEFR of 459.19 L/Min with a S.D. of 36.41; the children of 171-180 cms height group had a mean PEFR of 511.54 L/Min with a S.D. of 32.43.

IV. Discussion

Height And Pefr

The minimum and maximum height of 268 boys were 102 cms and 177 cms respectively. The minimum and maximum height of 227 girls were 101 cms and 165 cms respectively.

The mean values of height of children of various age groups fell within the normal ranges for school children and were comparable to those of children of other studies. (Malik .S.K. et al) . The mean height of all the subjects was 140.21 cms. with a S.D. of 20.05. The mean height of 268 boys was 143.19 cms with a S.D. of 21.18. The mean height of 227 girls was 136.69 cms with a S.D. of 18.0.

The standard error of estimate which measures the scatter index was 20.47 for boys, 16.36 for girls, and 17.19 for both sexes combined. The mean height along with mean PEFR in individual age groups in boys,girls and all subjects are shown in Tables 1,2 and 3 respectively.

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From these values, the progressive increase of PEFR with height is obvious. The mean PEFR of boys in various height groups closely match that of the girls till the age of 14 years. After 14 years, PEFR values of the boys are higher and more progressive than that of the girls, because the growth period of boys is prolonged than that of girls until maturity.

Apart from the influence of this differential growth in sexes, the performance of the PEFR test in an individual is affected by various factors like genetic factor, nutrition,environment and co-operative attitude.Height is an outward expression of the nutritional standards of growing child. Nutritional standards are a major determinant of ventillatory capacity in children with increasing age, height and lung capacities increase within the same age group. A well nourished child with greater height who can putforth a greater muscular effort can give a greater PEFR reading.

Though full efforts have been made to get the subjects best cooperation it is possible that some of the children might not have given their best performance during the test. Also some might not have recalled the previous history of chest illness correctly and might have had subtle grade of asymptomatic small airways obstruction which is not detectable by PEFR test.In addition genetic makeup of the individual which contributes to one third of the phenotypic expression, also influences the performance of the individual.

The correlation of the PEFR with height is positive and highly significant. The statistical significance of this relationship is shown by the correlation co-efficients of PEFR with respect toheight i.e., r=0.968 in boys, 0.949 in girls and 0.962 when both sexes are combined.The P value is less than 0.001 in all the cases which is highly significant.

Regression equations based on height for predicting PEFR in different sexes are as follows;
Boys : PEFR= -392.37+5.15xHt. cms SEE: 20.47
Girls : PEFR = -351.24+4.83xHt.cms SEE: 16.36
Common eqn : PEFR = -389.79+5.04xHt cms SEE: 17.19

Height has been taken as the basis for the nomogram to estimate the value of PEFR in a given individual for the following reasons :

1) Height has a close and statistically significant correlation with PEFR ($r=0.962$ and $P < 0.001$)
2) Height can be easily measured using just a measuring tape.
3) Height can be measured accurately if proper technique is used.
4) The formula based on height gives the best approximation of observed values.

The final Nomogram has been shown in relation to the observed values of PEFRs with respect to height in the present study. The uniform and close distribution of the values is obvious.

V. Conclusion

PEFRs were measured in a sample of 495 urban school going children from SINDHANUR. This sample comprised of 268 boys and 227 girls in the age group 5-18 years. The mean values of age, height and PEFR were 11.5 yrs,140.21 cms and 328.18 L/min respectively.The correlation of PEFR with height was statistically significant. A height standardized nomogram has been constructed from which PEFR values can be predicted in a given individual. With the detailed statistical analysis and discussion it is quite evident that the present study is statistically highly significant and can be considered as a standard reference for the child population of South India.

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