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Peak expiratory flow rate and its correlation with body surface area in healthy school children

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Abstract

Aims: The aim of this study was to correlate the " peak expiratory flow rate " as measured by miniature wright peak flow meter in normal children between 5-18 years of age with Body Surface Area (B.S.A). **Objectives:** This study was done to correlate the physical attributes (B.S.A) of healthy children with PEFR. **Study area:** R.G.M. School Sindhanur. **Study design:** This is an observational study of 495 urban school going healthy children from Sindhanur. This sample comprised of 268 boys and 227 girls in the age range of 5-18 years. **Results:** PEFR increased linearly with increase in B.S.A. The correlation of PEFR with B.S.A was statistically significant. **Conclusion:** The present study has led to the following conclusions- **A.** There is a positive and statistically significant correlation between PEFR and B.S.A. in the sample of children selected. **B.** B.S.A has a close correlation with PEFR.

Keywords: Peak Expiratory Flow Rate (PEFR), Peak Flow Meter, Body Surface Area (B.S.A)..

Introduction

The physiological principles underlying pulmonary function in health and disease were understood in surprising detail during past three hundred years.[1] The pulmonary function tests have not only widened the knowledge about the functional capability of the lungs in normal healthy persons but also have made it possible to assess the functional abnormalities in persons with restrictive and obstructive airway disorders both qualitatively and quantitatively.[2] The important functional abnormality in patients disabled by asthma, bronchitis, emphysema and other COPDs (Chronic Obtructive Pulmonary Disorders) is the difficulty in expiration.[3] Hence the measurement of Peak Expiratory Flow Rate (PEFR) has gained worldwide acceptability as a method for identification, assessment, rational therapy and follow up of such patients.

PEFR is defined as the maximal expiratory flow rate which can be sustained by a subject for at least 10 milliseconds during forced expiration starting from total lung capacity.[4] PEFR is expressed in litres/min. PEFR is influenced by various factors such as age, sex, height, weight, body surface area, environment and ethnic differences.[5] 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.[6] This instrument has undergone many changes and reached its present form known as the miniature wright peak flow meter (Figure 1).

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.[7]

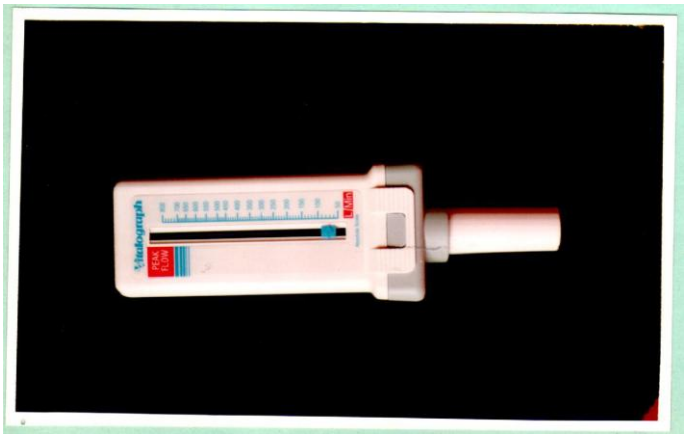

Figure 1: Peak flow meter

Methodology

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, Raichur, India)

The following criteria were employed for acceptance as a Normal subject.[7]

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

Instrument

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.

Operation and use

Air blown into the 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.[8]

Methods

Each child was weighed with normal light clothing and height of each child was measured without shoes. The surface area was calculated in each case by means of a Dubois Nomogram using the directly measured height and weight readings.

The purpose and technique of the test were 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 maintains an airtight seal between the lips and mouthpiece of the instrument. Each child blew five times into the flow meter and three maximum readings were recorded.

The Student ‘ T ‘ test was applied to evaluate the statistical significance. The confidence limit of the above work is 99.99 %.

Results

The children in 0.60-0.90 Sq.mts B.S.A. group had a mean PEFR of 204.07 L/Min. with a S.D. of 39.30; the children in 0.91-1.20 Sq.mts B.S.A. group had a mean PEFR of 303.87 L/Min. with a S.D. of 40.64; the children in 1.21-1.50 Sq.mts B.S.A. group had a mean PEFR of 400.08 L/Min. with a S.D. of 35.57; the children in 1.51-1.80 Sq.mts B.S.A. group had a mean PEFR of 477.83 L/Min with a S.D. of 32.48; the children in 1.81-1.90 Sq.mts B.S.A. group had a mean PEFR of 553.33 L/Min. with a S.D. of 30.91.

The minimum and maximum B.S.A. of 268 boys were 0.64 and 1.86 Sq.mts respectively. The minimum and maximum B.S.A. of 227 girls were 0.64 and 1.61 Sq.mts respectively. The mean B.S.A. in Sq.mts of all the 495 subjects was 1.14 with a S.D. of 0.32. The mean B.S.A. in Sq.mts of 268 boys was 1.19 with a S.D. of 0.33. The

mean B.S.A. in Sq.mts of 227 girls was 1.03 with a S.D. of 0.29. The mean values of B.S.A of children of various age groups fell within the normal ranges for school children and were comparable to those of children of other studies. (Nairn J.R. *et al*).[9] The mean PEFR with S.D.; C.V. and S.E.M of all the subjects, boys and girls are shown in Table 3.

The children in 0.60-0.90 Sq.mts B.S.A. group had a mean PEFR of 204.07 L/Min. with a S.D. of 39.30; the children in 0.91-1.20 Sq.mts B.S.A. group had a mean PEFR of 303.87 L/Min. with a S.D. of 40.64; the children in 1.21-1.50 Sq.mts B.S.A. group had a mean PEFR of 400.08 L/Min. with a S.D. of 35.57; the children in 1.51-1.80 Sq.mts B.S.A. group had a mean PEFR of 477.83 L/Min with a S.D. of 32.48; the children in 1.81-1.90 Sq.mts B.S.A. group had a mean PEFR of 553.33 L/Min. with a S.D. of 30.91.

It is clear from the above findings that PEFR and B.S.A are positively related. This relation is further evidenced by the statistically significant co-efficients of correlation values i.e. , r = 0.976 in boys , 0.948 in girls and 0.967 when both sexes are combined. P value is less than 0.001 in all the cases.

Regression equations based on B.S.A for predicting PEFR in different sexes are as follows;

Boys : PEFR = - 40.70 + 329.43 x B.S.A in Sq.mts

Girls : PEFR = - 20.51 + 305.30 x B.S.A in Sq.mts

Common eqn : PEFR = - 36.44 + 320.49 x B.S.A in Sq.mts.

Body surface area is a function of both height and weight and therefore is a good outward expression of nutritional standard of the individual.PEFR calculated from the regression equation based on B.S.A is 367 L/Min.

Table 1: The percentage distribution of the subjects with respect to body surface area

	Total (495)		**Boys (n=268)**		**Girls (n=227)**	
Body surface area (Sq.mts)	No	%	No	%	No	%
0.60- 0.90	140	28.3	68	25.4	72	31.7
0.91- 1.20	150	30.3	72	26.9	78	34.4
1.21- 1.50	130	26.3	73	27.2	57	25.1
1.51- 1.80	69	13.9	49	18.3	20	8.8
1.81- 1.90	6	1.21	6	2.2	-	-

Table 2: The mean B.S.A with S.D., C.V. and S.E.M. of boys, girls and all subjects

Body surface area (Sq.mts)	**Whole series**	**Boys (n=268)**	**Girls (n=227)**
Mean	1014	1.19	1.08
S.D.	0.32	0.33	0.29
C.V. %	27.82	28.06	27.18
S.E.M.	0.01	0.02	0.02

Table 3: The mean PEFR with S.D., C.V. and S.E.M. of boys, girls and all subjects with respect to body surface area

Body surface area (Sq.mts)	Total (n=495)	Mean	S.D.	C.V. %	S.E.M.
0.60-0.90	140	204.07	39.3	19.26	3.32
0.91-1.20	150	303.87	40.64	13.37	3.32
1.21-1.50	130	400.87	35.57	8.89	3.12
1.51-1.80	69	477.83	32.48	6.8	3.91
1.81-1.90	6	553.33	30.91	5.59	12.62

Discussion

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 Co-efficients (r) of PEFR obtained in the present study has been compared with those of other work done in North India and Western Countries.[10] The values in different studies are in close concordance with each other.[11]

Conclusion

PEFRs were measured in a sample of 495 urban school going children from Sindhanur, Raichur, India. This sample comprised of 268 boys and 227 girls in the age group 5-18 years. The mean values of age, height, weight, B.S.A. and PEFR were 11.5 yrs, 140.21 cms, 32.84 Kgs, 1.14 Sq.mts and 328.18 L/min respectively. The correlation of PEFR with height and B.S.A. was statistically significant. 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.

The present study has led to the following conclusions:

- There is a positive and statistically significant correlation between PEFR and B.S.A.
- B.S.A has a close correlation with PEFR.

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