Original Article

Peak Expiratory Flow Rate in Healthy Children from Tehran

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Abstract

Background: Measuring peak expiratory flow rate has been suggested as an important tool in asthma management by all international guidelines.

Objective: Studies on various populations have shown considerable variations in normal values of peak expiratory flow rate. Since reference standards for Iranian children are not available, the present study was performed to establish these standards.

Methods: This study was conducted on 1535 normal schoolchildren (767 female, 768 male), aged 6-14 in Tehran. A mini Wright peak flow meter was used to measure peak expiratory flow rates. The highest of the three readings was taken as the correct value. Regression analysis was used to calculate the predicted normal values of peak expiratory flow rate and also to assess its relationship to age, weight, height, and surface area.

Results: Peak expiratory flow rate values increased with age and were in strong correlation with the studied anthropometric measurements. Except for the 145-159 cm interval, the male children showed significantly higher values ($P<0.01$) of peak expiratory flow rate in comparison to female children.

Conclusion: The peak expiratory flow rates for Iranian schoolchildren were similar to some of those reported from other countries and could be used by Iranian physicians for proper management of paients.
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Keywords • Child • peak expiratory flow rate • Iran

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Introduction

The peak flow meter is a useful instrument for monitoring peak expiratory flow rate (PEFR) in children and adults.[1] Repeated PEFR measurements have been widely used in clinical and epidemiological studies for assessing the severity of asthma and bronchial hyper-reactivity since about 4o years ago.[2-4] In addition, they are used to measure changes which occur in pulmonary function after treatment or environmental exposures.[5,6] The measured PEFR is compared with the subject's predicted PEFR which is matched to the same sex, age, body size and ethnic group.

Table 1: PEFR (l/min) values for girls and boys in relation to age.

Age (years)	Girls		Boys	
	Number	PEFR	Number	PEFR
6	96	210(4)*	118	209(3)
7	123	229(3)	107	231(4)
8	111	256(3)	104	269(4)
9	83	258(4)	107	276(4)
10	89	291(4)	82	292(4)
11	44	350(6)	53	345(6)
12	103	361(4)	98	392(6)
13	83	378(5)	76	406(5)
14	35	391(10)	23	421(9)
Total	767		768	

* : Values in parentheses are Standard Error Mean

Normal values and prediction formulae have been established for different children of European, American, African and Asian countries.[7-13]

Patients and Methods

The present study was undertaken to determine the normal values of PEFR for Iranian children. It was conducted on 1535 children (767F and 768M) between the ages of 6 and 14 (average age: 10.43±3.57) in 10 primary and secondary schools of 4 different areas of Tehran (altitude: about 1191 m above sea level). The schools, chosen randomly, reflected the socioeconomic status of the city. Permission was obtained from the school authorities. The exclusion criteria were based on the American Thoracic Society 1987 recommendations[14] and children with cough, chronic or recurrent respiratory illnesses, asthma history, heart disease or tuberculosis were not enrolled in the study. The purpose of the PEFR measurement was explained and the procedure was shown to the subjects.

Measurements were taken between 0800h and 1200h in winter. The age and sex of all the children were recorded. Height and weight were measured without shoes, with the children wearing their usual school uniforms or clothings. The surface area was calculated using the Mosteller's formula:

$$\text{Surface area} = \sqrt{\frac{\text{Height}_{cm} \times Weight_{kg}}{3600}}$$

For the PEFR measurement, mini–Wright peak flow meters were used. The children blew into the device three times, while standing straight and without wearing a nose clip and carefully being watched by a single observer. The highest of the three results obtained was taken as the final PEFR for each subject.[2, 5]

Table 2: PEFR (l/min) values in girls and boys by height intervals.

Height interval (cm)	Girls		Boys	
	Number	PEFR	Number	PEFR
105-109	6	172(10)*	7	194(13)
110-114	32	198(5)	34	203(3)
115-119	57	205(4)	81	209(4)
120-124	111	223(3)	79	233(4)
125-129	72	246(4)	87	250(3)
130-134	81	256(4)	90	267(3)
135-139	76	269(5)	81	300(5)
140-144	63	308(6)	66	319(6)
145-149	65	338(5)	37	323(8)
150-154	91	365(4)	57	350(6)
155-159	72	386(5)	25	380(6)
160-164	33	396(9)	65	397(5)
165-169	8	426(22)	15	436(13)
170-174	0	-	34	450(7)
175-179	0	-	10	460(23)
Total	767		768	

* : Values in parentheses are Standard Error Mean

Multiple linear regression, 95% confidence intervals and Pearson correlation coefficients were used for data analysis. The SPSS was used for all of the statistical analyses.

Results

The PEFRs in relation to age are presented in Table 1. As demonstrated, most of the PEFR values were higher in boys than in girls, and this was more significant during puberty. It is also, seen in Table 1, the difference in PEFR increased between the two sexes after the age of 11 due to a faster increase of PEFR in boys.

Table 2 shows the PEFR values in relation to sex and height. The PEFR elevated with increasing height. The rate of increase was similar in boys and girls until a height of 135 cm reached, with boys having values about 30 l/min higher than girls. But in girls, this difference was compensated soon at the height range of 140-144cm. Also, the male children showed significantly higher values (P<0.01) of PEFR in comparison to female children, except in the 145-149 cm interval.

The relationship observed with height was more regular than with the other anthropometric measurements (Table 3).

The best equations for calculation of PEFR in children were obtained by considering separate equations for boys and girls. Since the applied parameters, height and age, were shown to be normally distributed, the exact figures were used without logarithmic transformation or quadration. The regression equations were calculated as:

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Table 3: PEFR (l/min) values in girls and boys by weight intervals.

Weight interval (kg)	Girls		Boys	
	Number	PEFR	Number	PEFR
15-19	70	201(5)*	41	204(4)
20-24	187	225(3)	172	224(3)
25-29	123	256(3)	179	264(3)
30-34	94	299(5)	87	295(5)
35-39	85	343(5)	87	342(5)
40-44	91	348(6)	49	355(7)
45-49	56	365(7)	48	363(9)
50-54	27	362(11)	26	415(13)
55-59	14	403(17)	30	401(9)
60-64	13	401(20)	20	443(15)
65-69	5	416(34)	8	409(17)
70-74	2	435(15)	9	448(22)
75-79	0	-	3	407(37)
≥80	0	-	9	438
Total	767		768	

*Values in parentheses are Standard Error Mean

PEFR= (2.2 x height) + (11.6 x age) – 147 ($P<0.05$, $r^2=0.76$; girls), and

PEFR= (1.9 x height) + (10 x age) – 142 ($P<0.05$, $r^2=0.76$; boys).

Discussion

Physicians usually refer to common international references for obtaining different normal values, but it has been shown that PEFR values vary with racial, socioeconomic and genetic features, and with lifestyle. Therefore, it would be more appropriate for each country to have its own values. In this study, we found that the PEFR values of the Iranian children were similar to those of some Europeans, Americans and Asians, but lower than those of Australians, and Sri Lankans.[12,13,15.] This study presents reference standards for PEFR in Iranian schoolchildren. Although the investigated children were from different parts of Tehran and from different social classes and thus probably representative of the general children population of Iran, further studies throughout the country is recommendable to derive standards for PEFR in other ethnic groups. The differences between the PEFR values of the Iranian children and those of other countries can be explained by factors like genetic properties, lifestyle, diet and anthropometrical measurements (weight, height and surface area) as well as environmental conditions.

Acknowledgements

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