Ind. J. Physiol. Pharmac., Volume 33, Number 4, 1989

PEAK EXPIRATORY FLOW RATES IN LIBYAN ADOLESCENTS

MASOUD-SHERIF R. MUKHTAR, GUTTI MADAN MOHAN RAO* AND LUTIFIA OMAR MORGHOM

Department of Physiology,
Faculty of Medicine,
The Great Al-Fateh University of Medical Sciences, Tripoli, Libya

(Received on April 3, 1989)

Abstract : Peak expiratory flow rates of 578 Libyan boys and 527 Libyan girls aged 12 to 21 years were determined. The prediction formulae that best describe the data are as follows :

Boys : $PEFR = 160 \times Stature^{1.87}$

Girls : $PEFR = 130 \times Stature^{2.44}$

Statistically significant correlations were found between peak expiratory flow rate (PEFR) and standing height, sitting height, body mass index, body surface area and age in both sexes. Stature (standing height) is marginally better as an index of body size in explaining the variability of the ventilatory capacity.

The relationship between PEFR and age in girls appears to correlate with the relationship between PEFR and body mass index. The difference in the slope for girls when compared with that for boys is attributed to the obesity/over weight of the girls.

Key words : peak expiratory flow rate, stature, sitting height, body mass index, body surface area

INTRODUCTION

The measurement of peak expiratory flow rate (PEFR) is useful in the clinical assessment of airway obstruction. For this purpose, evaluation of an observed reading requires knowledge of its range in normal subjects of the same age, sex and body size. There have been no reports of normal values of PEFR for Libyan population. Hence, this investigation was undertaken to determine the normal standards of PEFR in Libyan boys and girls aged 12 to 21 years and to construct prediction formulae.

*Corresponding Author

Dr. G. M. M. Rao, Professor of Physiology, P. O. Box 13366, Tripoli, Libya

METHODS

Libyan boys (n=578) and girls (n=527) were selected randomly from 24 schools and the Great Al-Fateh University of Medical Sciences, all located in Tripoli, Libya. All subjects were healthy receiving no medication at the time of the study. Immediately before the pulmonary function test, a questionnaire was filled out at an interview with the subject, to make sure that the subjects included in the survey satisfied the criteria of normal and healthy subjects. Age, sex, standing and sitting

heights, and body weight of each subject were recorded. Age was recorded to the nearest 6 months from the date of birth, body weight was measured to the nearest 0.1 kg with a portable weighing scale and height to the nearest 0.1 cm with a portable height scale. The height and weight scales were calibrated daily before the measurements were taken.

The peak expiratory flow rate was obtained with Wright's Peak Flow Meter while the subject was standing. A nose clip was used. The peak flow meter was calibrated before and during the tests to make sure that the results obtained were accurate. At least three measurements were obtained and the best effort was selected. Rest for one minute was allowed between measurements.

Body mass index was calculated from the formula, BMI=Weight (kg)÷Height (m)^2 (1) and body surface area by the standard DuBois formula, BSA (cm^2)=Weight (kg)$^{0.425}$×Height$^{0.725}$×71.84(2).

The data were analysed with SPSS routines (3) at the Cripps Computer Centre, University of Nottingham, England. The mean, standard deviation and standard error of each variable were calculated. Logarithmic transformation to the base of peak expiratory flow rate on sex, age, height and weight were calculated. Single and multiple regression analyses were performed. P-value less than 0.05 was regarded as indicating statistical significance.

RESULTS

The mean values of height, weight and peak expiratory flow rates of Libyan boys and girls of different age groups are given in Table I. Except

TABLE I : Mean values of height, weight and peak expiratory flow rate of Libyan boys and girls of different age groups (±Standard error of the mean).

Age (yrs)	*Sex*	*Height (cm)*	*Weight (kg)*	*Peak expiratory flow rate (l/min)*	*Number of subjects*
12	Male	147.2±2.21	40.54±2.38	314.62±5.84	13
	Female	151.3±1.86	47.84±2.3	314.21±13.2	19
13	Male	149.8±1.5	45.53±2.38	349.63±5.84	40
	Female	152 ±0.99	49.4 ±1.88	324.00±9.32	47
14	Male	158.7±1.52	53.5 ±2.41	375.00±11.5	43
	Female	158 ±0.74	55.94±1.9	352.5 ±8.27	49
15	Male	164.4±1.19	57.04±1.55	417.9 ±9.7	83
	Female	158.9±0.7	56.86±1.3	380.3 ±7.53	73
16	Male	165.9±0.65	58.15±1.08	437.5 ±7.27	156
	Female	158.6±0.62	60.29±1 32	388.64±6.42	99
17	Male	169.1±0.8	60.56±1.57	469.4 ±8.97	69
	Female	160.0±0.61	61.75±1.23	396.07±7·72	79
18	Male	172.4±0.94	66.36±1.74	973.18±10.65	44
	Female	160.08±0.71	59.65±1.2	402.94±10.64	51
19	Male	173.4±0.9	65.08±1.41	515.94±11.6	53
	Female	159.3±0.78	58.36±1.23	398.09±7.04	55
20	Male	172.7±1.0	67.31±1.76	544.3 ±10.4	55
	Female	159.3±0.01	56.96±1.14	418.02±7.25	48
21	Male	172.6±0.014	64. 6±1.98	540.68±11.67	22
	Female	156.1±0.023	54.71±1.92	390.00±18.4	7
	Male	166.0±0.44	59.0 ±0.6	450.6 ±4.128	578
TOTAL	Female	158.2±0.28	57.57±0.51	381.8 ±2.97	527

for the age of 21 years, all age groups were well represented in both sexes. Linear relationships with statistically significant correlations ($P<0.001$) were found between the mean peak expiratory flow rates and the mean values of stature (standing height), sitting height, body mass index and body surface area in boys and girls (Figs. 1, 2, 3 and 4).

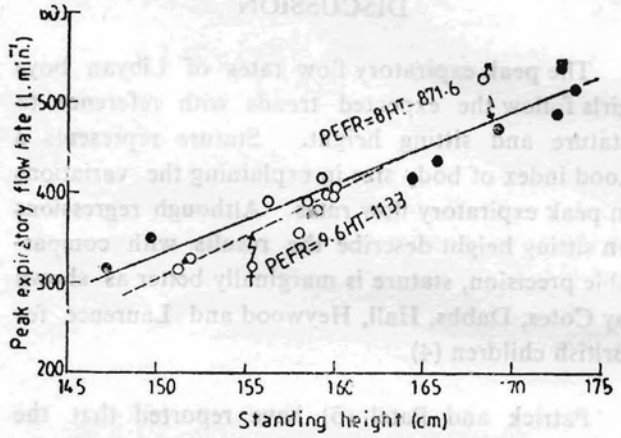

Fig. 1. Correlation between stature (standing height) and peak expiratory flow rate in Libyan boys and girls.

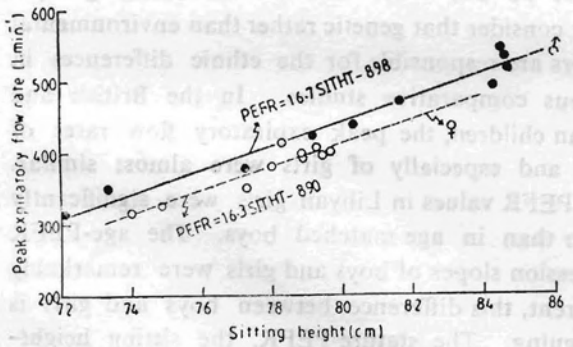

Fig. 2. Relationship between sitting height and peak expiratory flow rate in Libyan boys and girls.

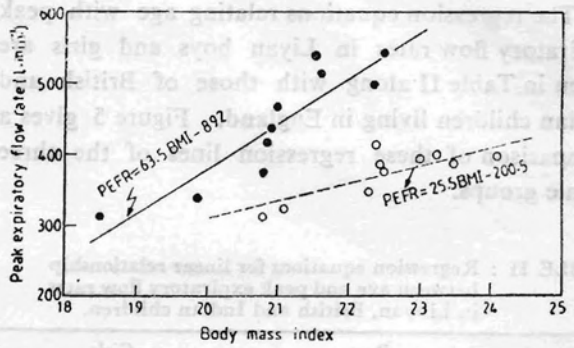

Fig. 3. Correlation between body mass index and peak expiratory flow rate in Libyan boys and girls. ● boys ; o girls

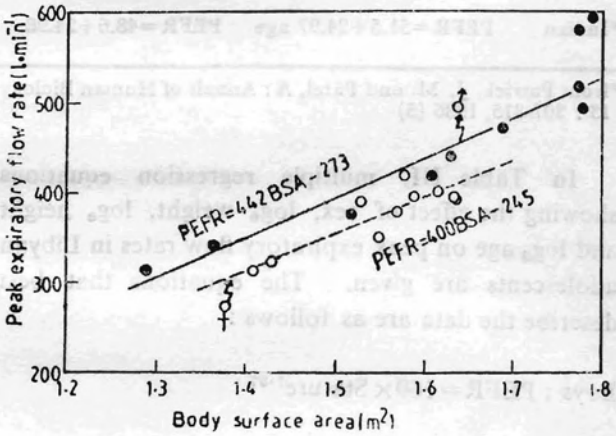

Fig. 4. Relationship between body surface area and peak expiratory flow rate in Libyan boys and girls.

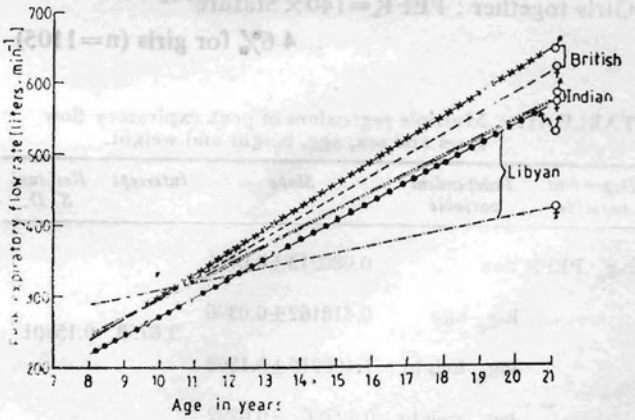

Fig. 5. Relationship between age and peak expiratory flow rate in Libyan, Indian and British boys and girls.

The regression equations relating age with peak expiratory flow rates in Liyan boys and girls are given in Table II along with those of British and Indian children living in England. Figure 5 gives a comparison of these regression lines of the three ethnic groups.

TABLE II : Regression equations for linear relationship between age and peak expiratory flow rates in Libyan, British and Indian children.

	Boys	*Girls*
Libyan	PEFR=9.84+26.4 age	PEFR=212+9.96 age
*British	PEFR=31.7 age−20.88	PEFR=30.3 age−2.92
*Indian	PEFR=51.5+24.97 age	PEFR=48.6+24.98

*from Patrick, J. M. and Patel, A : Annals of Human Biology 13 : 307-315, 1986 (5)

In Table III, multiple regression equations showing the effect of sex, $\log_e$ weight, $\log_e$ height and $\log_e$ age on peak expiratory flow rates in Libyan adolescents are given. The equations that best describe the data are as follows :

Boys : $PEFR = 160 \times Stature^{1.87}$

Girls : $PEFR = 130 \times Stature^{2.44}$

Both boys and
Girls together : $PEFR = 140 \times Stature^{2.29}$

...4.6% for girls (n=1105)

TABLE III : Multiple regressions of peak expiratory flow rates and sex, age, height and weight.

Dependent variable	*Independent variable*	*Slope*	*Intercept*	*Residual S. D.*
$\log_e$ PEFR	Sex	0.080213±0.0111		
	$\log_e$ age	0.418162±0.0396	3.6798	0.15901
	$\log_e$ height	1.460216±0.1268		
	$\log_e$ weight	0.12296 ±0 0292		

TABLE IV : Regression relationship of PEFR on stature (standing height) and on sitting height in the form of $\log_e$ index=a $\log_e$ HT or SITHT + b_{sex} + c

$\log_e$ *variable*	$\log_e$ *standing height*				$\log_e$ *sitting height*			
	a	b_{sex}	*c*	*SEE*	*a*	b_{sex}	*c*	*SEE*
$\log_e$ PEFR	2.291	−0.047	4.927	0.168	1.989	0.097	6.516	0.171

DISCUSSION

The peak expiratory flow rates of Libyan boys girls follow the expected trends with reference to stature and sitting height. Stature represents a good index of body size in explaining the variations in peak expiratory flow rates. Although regressions on sitting height describe the results with comparable precision, stature is marginally better as shown by Cotes, Dabbs, Hall, Heywood and Laurence for British children (4).

Patrick and Patel (5) have reported that the indices of ventilatory capacity reflecting thoracic size differ materially between the British and the Indian children living in England of the same age and stature and that the indices representing airway calibre do not differ between the ethnic groups. They consider that genetic rather than environmental factors are responsible for the ethnic differences in various comparative studies. In the British and Indian children, the peak expiratory flow rates of boys and especially of girls were almost similar. The PEFR values in Libyan girls were significantly lower than in age-matched boys. The age-PEFR regression slopes of boys and girls were remarkably different, this difference between boys and girls is intriguing. The stature-PEFR, the sitting height-PEFR and the body surface area PEFR regression slopes showed expected trends. Marked difference between boys and girls was noticed in the relationships of age and PEFR and body mass index and PEFR. In spite of the difference in PEFR between sexes, there was a significant correlation between

age and PEFR or between body mass index and PEFR. Hence, the disparity in the regression lines of boys and girls in the relation between age and peak expiratory flow rates is attributable to overweight and obesity observed in the Libyan girls. This contention is supported by a similar disparity in the regression lines of the correlation between body mass index and peak expiratory flow rates, as shown in Fig 3. Further work is needed to understand the lower slopes in the regression relationship between age and PEFR in Libyan girls as compared with Libyan boys as well as with girls of other ethnic groups.

ACKNOWLEDGEMENTS

The authors wish to express their thanks to the Principals of the Schools and the Education Secretariat of Tripoli for allowing us to have the measurement of their students and their appreciation for assistance to Miss Aisha Karaza, Mr. Ali Affan, Mr. Mahjub Zendah and Mr. Abdul Majid Dow. Our grateful thanks are due to Professor John M. Patrick, Department of Physiology & Pharmacology, University of Nottingham for assistance in the analysis of the data.

REFERENCES

1. Rao GMM, Morghom LO. Prevalence of Obesity in Libyan Diabetic patients. *Garyounis Med J* 1985; 8 (2) : 115-21.
2. Miale JB. Laboratory Medicine : Haematology, 4th edn. C. V. Mosby Co, St. Louis, 1972.
3. Nie NH Hull CH, Jenkins JG, Steinbrenner K, Bent DH. Statistical Package for the Social Sciences New York : McGraw Hill, 1975; 2nd edn.
4. Cotes JE, Dabbs JM, Hall AM Haywood C. Laurence : Sitting height, fat-free mass and body fat as reference variables for lung function in healthy British children : Comparison with stature. *Annals of Human Biology* 1979; 6 : 307-14.
5. Patrick, JM, Patel A. Ethnic differences in the growth of lung function in children : A cross-sectional study in the inner-city Nottingham, *Annals of Human Biology* 1986; 13 : 307-15.