PULMONARY FUNCTIONS AND THEIR CORRELATION WITH ANTHROPOMORPHIC PARAMETERS IN YOUNG ADULTS OF HARYANA (INDIA)

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Summary : Pulmonary functions in 169 young males of Haryana were studied with the help of a water seal spirometer and Wright's peak flow meter. Different parameters analysed were FVC, $FEV_1\%$, P.F.R., MVV, and expiratory flow rates between 25-50%, 25-75% and 50-75% of FVC. Our mean values are well comparable with those of Indian workers but less than those reported by Western workers.

Pulmonary functions correlate better with physical parameters, height arm span and upper segment than with age. Correlation coefficient (r) values of FVC with anthropomorphic parameters are +0.7953, +0.3835, +0.3566 and +0.0992 with arm span, upper segment, height and age respectively.

These values of pulmonary functions in healthy adults when compared with those obtained from patients suffering from chronic obstructive lung disease, it was observed that expiratory flow rates may be more useful in the detection of pulmonary changes in obstructive lung diseases at an early and reversible stage.

Key words: pulmonary functions, anthropomorphic parameters, peak flow rate, expiratory flow rates, correlation coefficient

INTRODUCTION

The focus of attention these days is on dynamic lung functions for the detection of early changes in obstructive lung diseases. For this purpose various expiratory flow rates being studied are Maximum midexpiratory flow rate (EFR 25-75%), Maximum expiratory flow rate (EFR .2-1.2 Lt.), Peak flow rate (PFR), End expiratory flow rate (EFR 75-85%), and EFR 50-75% of Forced vital capacity (1, 2, 4, 6, 9, 10, 16, 17, 18, 24).

The review of Indian literature reveals that most of the early workers have studied Forced vital capacity (FVC) alone (3), maximum voluntary ventilation with or without FVC (12, 21, 22) or $FEV_1\%$ with FVC and MVV (15) and only recently flow rates have been studied (2,6, 9, 10, 16). Pulmonary function tests have been correlated with various anthropometric parameters e.g. age, height, arm span, upper segment or sitting height, weight, body surface area (B.S.A.) and chest measurements.

In view of the marked variability in the values of pulmonary functions reported, the present work is undertaken to study lung functions and their correlation with physical parameters in young males of Haryana.

MATERIALS AND METHODS

One hundred and sixty nine healthy male medical students, 18-22 years of age were included in this study. They were all non-smokers and had no past or present history of respiratory or

allergic illnesses which could modify pulmonary functions. The following anthropomorphic and pulmonary function parameters were recorded for the analysis and comparison.

A. Anthropomorphic parameters:

Age : It was calculated in years to the nearest birthday.

Height : It was measured in cms. without shoes while standing erect.

Arm span : It was taken as the distance in cms. between the tips of middle fingers of both outstretched hands in standing position.

Upper segment : It was measured in cms. as the distance from upper border of symphysis pubis to vertex with the subject lying flat on the table and head touching the wall. As it measures the distance between two bony points, it was preferred to sitting height.

Weight and B.S.A. were not included in these parameters as weight is very much variable in adults in their life-time.

B. Pulmonary function tests were studied by using a low resistance water seal spirometer. The tests were performed while subject was sitting on a stool with nose closed by a nasal clip. Forced expiratory spirogram was recorded at a speed of 20 mm/sec. At least 3 satisfactory records were taken at an interval of 5 min and best of these was selected for calculations.

From the forced expiratory expirogram, in addition to FVC, $FEV_1\%$ and expiratory flow rates were calculated. The expiratory flow rate is average velocity between two points on expirogram curve. EFR 25-75% was calculated by joining the two points on expirogram corresponding to 25% and 75% of FVC and from this amount of air expired in 1 sec was calculated as shown in Fig. 1. Similarly EFR 25-50% and EFR 50-75% were calculated and values expressed as l/sec.

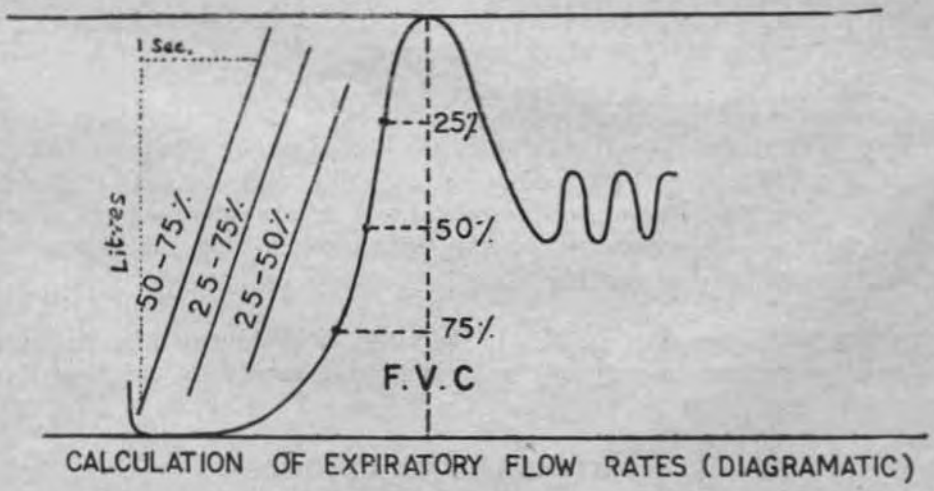

Fig. 1: Method of calculation of expiratory flow rates (diagramatic). Two points corresponding to 25, 50 and 75 percentage of FVC were joined and lines parallel to them were drawn to calculate flow in one sec.

Maximum voluntary ventilation (MVV) was measured by using the same spirometer but at slower speed (5 mm/sec.), the subject breathing maximally for 10 sec. Volume for 1 min was calculated from best of such 3 attempts. All volumes calculated by using spirometer were converted to body temperature, pressure, saturated with water vapour (B.T.P.S.).

Peak flow rate (PFR) was measured by using Wright's peak flow meter which gives direct reading in l/min and there is no need to convert it to B.T.P.S.

The data obtained was subjected to statistical analysis.

RESULTS AND DISCUSSION

The age-wise distribution of subjects along with their physical parameters is shown in Table I. In each age group the mean of arm span is more than mean of height, the difference in the two means being 3.9 cms. to 7.3 cms. Similarly upper segment is found to be less than the lower segment (Height minus upper segment) and the difference is upto 9.0 cms. Marya *et al.* (14) have also reported Marfan's like constitution in Haryanvi adult meals with arm span exceeding height by 8 cms. or more in 36.2% and lower segment exceeding upper segment by 5 cms. or more in 41.4% of the subjects.

Table I: Age wise distribution and values of anthropomorphic parameters.

Age in years	*No. of subjects*	*Height ± S.D. (cms)*	*Arms span ± S.D. (cms)*	*Upper segment ± S.D. (cms)*
18	28	168.2±6.02	173.6±6.67	79.9±3.77
19	37	168.8±3.76	172.7±6.34	81.1±4.83
20	52	169.4±6.07	174.3±7.42	80.2±3.87
21	39	168.8±6.93	175.7±6.24	81.8±3.96
22	13	169.0±5.80	176.3±7.22	80.1±3.86
19.83±1.18	169	168.9±6.14	174.1±6.47	80.4±4.15

The observed values of different pulmonary functions along with their standard deviation are given in Table II. FVC in these subjects is quite comparable to the values obtained in other Indian subjects, though the values reported from northern parts (6, 9, 10) are slightly higher than those from other parts of the country (2, 12, 14, 16, 22). This may be due to the better physical growth of people in the northern parts of India. (8)

Our FVC values are lower than those reported in western subjects. This may be due to racial differences in addition to shorter height of Indian subjects. In fact our FVC values are quite in agreement with those of Oriental subjects of Seltzer *et al.* (20). The correlation with anthropomorphic parameters in this study shows almost a linear correlation with arm span (r + 0.7953), upper segment (r + 0.3835) and height (r + 0.3566). The correlation with age is not significant (Table IV).

Table II: Values of pulmonary function tests at different age groups.

Age	*FVC*±*S.D.* (l)	*MVV*±*S.D.* (l *mt*)	*FEV_1%*±*S.D.*	*Expiratory flow rates* 25-50%±*S.D.* (l *sec*)	25-75%±*S.D.* (l *sec*)	50-75%±*S.D.* (l *sec*)	*PFR*±*S.D.* (l *mt*)
18	3.72±0.45	129.2±20.4	85.6±10.6	6.16±1.90	5.23±1.69	4.12±1.10	481.8±40.2
19	3.90±0.59	139.1±25.1	82.0±12.0	5.21±1.90	4.51±1.21	3.95±1.51	507.5±48.9
20	3.78±0.48	128.5±29.0	80.2±11.4	5.36±1.74	4.36±1.00	3.63±0.95	504.7±49.5
21	3.97±0.43	142.6±30.0	75.4±12.5	5.70±2.59	4.20±1.73	3.50±1.36	505.3±37.7
22	3.84±0.44	134.6±16.5	69.8±16.8	4.70±1.68	4.47±1.59	3.98±1.30	511.7±56.3
Total	3.85±0.49	134.7±26.8	81.5±13.55	5.56±1.95	4.58±1.64	3.77±1.23	501.5±46.6

Table III : Comparison of values of pulmonary function tests with Indian and Western authors.

Author Name	Year	*Age range*	*FVC*	*MVV*	*FEV_1%*	*EFR* 25-75%	*EFR* 50 75%	*PFR*
Indian								
(21) Singh	59	18—29	3.54	131.0	—	—	—	—
(12) Khandare	61	18—33	—	118.3	—	—	—	—
(10) Kasliwal *et al.*	64	16—25	4.21	126.5	80.5	4.02	—	—
(22) Talsania *et al.*	65	17—29	3.38	158.6	—	—	—	—
(15) Mathur *et al.*	68	16—20	3.89	124.6	71.4	—	—	—
(9) Jain *et al.*	69	19—22	4.11	139.0	82.8	3.67	—	—
(2) Bhargava *et al.*	73	16—25	3.04	142.5	87.8	4.83	—	—
(6) Gupta *et al.*	75	18—40	4.07	133.0	81.0	3.22	—	537.7
(16) Mazumdar *et al.*	76	18—20	3.05	—	88.2	1.32	—	—
Western								
(24) Wright *et al.*	62	30.84	—	145.0	74.3	3.00	—	527.0
(19) Peters *et al.*	67	21.02	5.32	—	87.5	—	—	601.6
(17) Morris *et al.*	71	20—29	5.57	—	80.6	4.87	—	—
(1) Bass	73	21—31	4.70	150.0	78.0	—	—	498.0
(4) Black	74	20—29	5.32	—	—	—	4.13	—
Present	76	18—22	3.85	134.7	81.5	4.58	3.77	501.5

The values of MVV (Table II) are quite comparable to those reported by other workers (2, 6, 9, 15). MVV showed a positive correlation with physical parameters and was significantly related to the upper segment ($P<0.001$) and to lesser extent with arm span ($P<0.01$) and height ($P<0.05$). The correlation was not significant with age (Table IV).

Our values of FEV_1% are well comparable with those of other workers, although slightly towards lower side. FEV_1% had significant negative correlation with all the physical parameters, more marked with age (Table IV).

Table IV: Correlation coefficient (r) between anthropomorphic parameters and pulmonary function.

Pulmonary function	*Age*	*Height*	*Arm Span*	*Upper segment*
FVC	+0.0092	+0.3566***	+0.7953***	+0.3835***
MVV	+0.0458	+0.1923*	+0.2694**	+0.2868***
$FEV_1\%$	−0.8766***	−0.3656***	−0.3350***	−0.3290***
EFR 25-50%	+0.0818	−0.0112	+0.0892	+0.0814
EFR 25-75%	+0.4176***	+0.7580***	+0.7479***	+0.3979***
EFR 50-75%	+0.2006*	+0.1114	+0.2164*	+0.0480
PFR	+0.1540	+0.2455**	+0.1552	+0.0911

***P<.001 **P<.01 *P<.05

Table V: Comparison of values of pulmonary function observed in this study with the values observed in patients of obstructive lung disease (23).

Subjects	*Pulmonary function*					
	FVC	*MVV*	*$FEV_1\%$*	*EFR 25-50%*	*EFR 25-75%*	*EFR 50-75%*
Normal	3.85	134.7	81.5	5.56	4.58	3.77
Chronic bronchits	2.82	54.3	68.3	1.80	1.25	0.96
Emphysema	1.85	34.4	48.4	1.08	0.74	0.60
Chronic or pulmonale	1.28	16.8	56.0	0.82	0.60	0.52

Expiratory flow rates are being increasingly used for the early detection of lung involvement. Commonly EFR 25-75% is studied but recently more stress is being given to the later part of expirogram from where flow rates at low lung volumes can be calculated and are more likely to show increased resistance in the peripheral parts of lungs. For this purpose Black *et al.* (4) have studied EFR 50-75% while Morris *et al.* (17) have advocated EFR 75-85%. The value of EFR 25-75% and 50-75% are well comparable with other workers (Table III), and their correlation with physical parameters is shown in Table IV. PFR in our subjects is quite comparable with others (1, 6, 24) although lower than reported by Peters *et al.* (19). A poor correlation of PFR with physical parameters was observed.

In this study pulmonary function tests have shown better correlation with height arm span and upper segment than with age (Table IV). The correlation of pulmonary function with arm span and upper segment has not been studied earlier in India, western authors have reported significant correlation of pulmonary function with arm span (5, 7) and upper segment or sitting height (11).

Comparison of values of pulmonary functions in our subjects with those of patients of COLD observed in this laboratory (23) shows that there was reduction of all expiratory flow rates in patients of COLD (Table V). Theoretically EFR 50-75% should be more helpful in early detection of lung changes in obstructive lung diseases as it is in the later part of the effort independent portion of forced expirogram.

It is suggested that EFR 25-75% and 50-75% may be included in the pulmonary function tests for the detection of early lung changes in obstructive lung diseases. Arm span, which is easily measurable should be used as an alternate to height in patients with chest and spinal deformities.

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