PREDICTION OF SOME VENTILATORY 'NORMS' IN HEALTHY INDIAN MALES 21–69 YEARS AGE

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Summary : This paper presents regression equations for predicting some ventilatory 'norms' (viz. vital capacity, forced vital capacity, forced expiratory volume for one second, expiratory reserve volume, inspiratory capacity and maximum voluntary ventilation) from physical characteristics of healthy Indian males. These equations have been constructed on the basis of multivariate regression analysis of the data of ventilatory 'norms' and physical characteristics collected on 171 healthy Indian males of age ranging from 21–69 years. Applications of these regression equations will be of practiced importance to biomedical scientists interested in the indirect assessment of ventilatory 'norms for a wider age range (21–69 years) which has not been covered by the earlier studies carried out in this direction.

Key words : ventilatory 'norms, regression equations, coefficient of determination, analysis of variance, multivariate regression analysis

INTRODUCTION

Regression equations have been developed for indirect estimation of ventilatory 'norms' in terms of physical characteristics by several workers for narrow age ranges. Jain and Ramiah (9, 10, 13) have estimated lung function tests from age, height, body weight and body surface area for men and women in the age range of 15–40 years. Similar regression equations were also established for men and women in the age range of 40–65 years (7, 8). For boys of the age ranging from 7 to 14 years, the ventilatory 'norms' were also estimated using age, height and body weight as predictors (11, 12). Perhaps no attempt has yet been made to evolve suitable regression equations of wide applicability for estimating ventilatory 'norms' in terms of physical characteristics. It was, therefore, thought to provide simple regression equations for the indirect assessment of some ventilatory 'norms' applicable for a wider age range. Thus the main aim of this paper is to evolve simple regression equations for indirect assessment of some ventilatory 'norms' (viz.

vital capacity, forced vital capacity, forced expiratory volume for one second, expiratory reserve volume, inspiratory capacity and maximum voluntary ventilation) for a wide age range of 21-69 years in healthy Indian males.

MATERIAL AND METHODS

Physiological data and statistical analysis :

Physiological data on some ventilatory 'norms' were obtained on a random sample consisting of one hundred and seventy one human male subjects with the age ranging from 21 to 69 years. All these subjects were clinically examined and found normal, free from any chest disease. These subjects reported in the morning and the tests were conducted between 9.00 hrs to 12.00 hrs. The ventilatory 'norms' studied were vital capacity (VC), forced vital capacity (FVC), forced expiatory volume for one second (FEV_1), inspiratory capacity (IC) and maximum voluntary ventilation (MVV). A calibrated spirometer was used for the determination of these lung function tests. The best of three efforts of the spirogram was analysed for these values.

The coefficients of correlation of different ventilatory 'norms' with age, height and body weight were calculated and their statistical significance from zero correlation were tested using standard statistical tests. Based on significant regression coefficients at 0.1% level of significance, the linear regression equations of the form : $Yi = a_0+b_1x_1+b_2x_2$ were worked out for predicting ventilatory 'norms' (Yi) from age (x_1), height (x_2) and body weight (x_3) by multivariate regression analysis. The coefficient of determination ($R^2\%$) for each regression equation was calculated and its significance was tested by F-test (1). Overall significance of each regression equation was tested by the analysis of variance technique.

RESULTS

Table I presents the physical characteristics and ventilatory 'norms' of 171 healthy Indian males. The coefficients of correlation between ventilatory 'norms' and physical characteristics (age, height and body weight) are shown in Table II. Coefficients of determination, standard error of estimate and regression equations established on the basis of significant regression coefficients for predicting ventilatory 'norms' from age, height and body weight are presented in Table III. All the regression coefficients and coefficients of determination ($R^2\%$) presented in Table III, have been found to be highly significant ($P<0.001$).

TABLE I : Physical characteristics and ventilatory norms of subjects.

Variables	*Statistics*		
	Mean	*SEM*	*Range*
Physical characteristics			
Age *(yr)*	43.8	1.03	21—69
Height *(cm)*	170.1	0.44	156.5—188.0
Body weight *(kg)*	59.0	0.67	43.6—78.2
Ventilatory 'norms' (BTPS)			
VC (l)	4.02	0.05	2.52—6.31
FVC (l)	3.97	0.05	2.34—6.10
FEV_1 (l)	3.00	0.05	1.25—4.42
ERV (l)	1.55	0.03	0.51—2.82
IC (l)	2.46	0.04	1.30—3.75
MVV (l/min)	114.32	2.33	25.71—168.60

SEM — Standard error of mean.

TABLE II : Coefficients of correlation between ventilatory 'norms' and physical characteristics.

Ventilatory 'norms' (BTPS)	*Physical characteristics*		
	Age (yr)	*Height (cm)*	*Body weight (kg)*
VC (l)	—0.6384***	0.4639***	0.2843***
FVC (l)	—0.6228***	0.4601***	0.2953***
FEV_1 (l)	—0.6512***	0.3714***	0.1370 NS
ERV (l)	—0.4396***	0.2467**	0.0769 NS
IC (l)	—0.5508***	0.5116***	0.4964***
MVV (l/min)	—0.7411***	0.1703*	0.1500*

NS — Not significant, * — $P<0.05$, ** — $P<0.01$, *** — $P<0.001$

TABLE III : Regression equations for predicting ventilatory 'norms' from physical characteristics.

Ventilatory 'norms'	*Coefficients of*			*Constant*	*Standard error of estimate*	*Coefficient of determination (R^2%)*
	Age (yr)	*Height (cm)*	*Body weight (kg)*			
VC (l)	—0.0303***	0.0461***	—	—2.4965	0.4765	54.45***
FVC (l)	—0.0281***	0.0438***	—	—2.2472	0.4648	53.40***
FEV_1 (l)	—0.0286***	0.0312***	—	—1.0474	0.4498	50.10***
ERV (l)	—0.0120***	0.0237***	—0.0129***	—1.1948	0.3713	26.41***
IC (l)	—0.0153***	0.0250***	0.0168***	—2.1053	0.3255	54.23***
MVV (l/min)	—1.6784***	—	—	187.8437	20.5421	54.92***

*** — $P<0.001$

DISCUSSION

The main aim of the present paper was to develop suitable regression equations for predicting some ventilatory 'norms' from physical characteristics in healthy Indian males for a wide age range. A multivariate regression analysis was thus performed to establish these regression equation based on the data of large number of subjects collected on 171 healthy Indian males with age ranging from 21 to 69 years. Age has been observed as a common factor in the assessment of all the ventilatory 'norms' considered in this investigation which is in agreement with some earlier workers (13). A low coefficient of determination ($R^2\% = 26.41$) has been observed for predicting expiratory reserve volume which may be due to the fact that there is some controversy as to the change in the resting breathing level with age and is also admitted that the residual volume increases and expiratory reserve volume declines, and these two volumes constitute the FRC. It is not certain whether the effect of these two changes is to leave the FRC unaltered or to cause an increase with age (2).

Studies have been carried out by other Indian workers to establish ventilatory 'norms' for healthy Indian population in the narrow ranges of age. Results of these studies were generally compared with Western standards. It has been reported that mean VC values in Indians were significantly lower than the Western subjects (3, 4, 6, 14, 16, 17, 18, 19). The present study also showed higher average vital capacity than the above mentioned Indian studies.

Obviously the regression equations thus evolved for predicting some ventilatory 'norms' in present paper are of great practical importance applicable for a wide age interval ranging from 21-69 years because such a wide age range has not been covered by earlier studies in this direction. Extrapolation of these regression equations beyond the ranges of ventilatory 'norms' of the present investigation (Table I) may lead significant error in prediction.

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