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To Assess Pulmonary Functions of Urban and Rural Adolescent Population In Barabanki District

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Abstract

Aim: The objective of the present study was to assess pulmonary functions of urban and rural adolescent population in Barabanki district, Uttar Pradesh, India.

Methods: It was an exploratory and observational study conducted at Department of Physiology, Hind Institute of Medical Sciences (HIMS), Safedabad, Barabanki, U.P., India. The rural and urban areas adjoining HIMS were also included in the study. It was conducted among the age groups of 10-19 years of healthy urban and rural adolescent population. The study groups included both boys and girls, with normal respiratory capability and without any major chronic illness, congenital and neurocognitive deficit. The pulmonary function tests were carried out by a computerized spirometer. Overall effect of age, height and weight on lung function variables (FVC, FEV1, PEFR, FEF25-75%) were tested by applying analysis of variance. Correlations were calculated and their significance were tested by applying "t" test. The ethical approval for this study was obtained from Institutional Ethical Committee.

Results: A linear relationship between the spirometric functions and physical characteristics (age, height and weight) was observed in both boys and girls. The values of pulmonary function test parameters (FVC, FEV1, PEFR and FEF25-75%) increased with increase in height($p<0.001$), age($p<0.001$) and weight ($p<0.05$). Higher values for lung function test parameters were observed in boys than girls and among rural adolescents than urban. The differences were more significant when

these lung function variables were compared among same age adolescents.

Conclusion: The present study established reference standards for predicting spirometric values in healthy school going adolescents of Barabanki, U.P., India showing significant correlation between anthropometric indices and PFT parameters (FVC, FEV1, PEFR and FEF25-75%) in both urban and rural boys and girls.

Keywords: Anthropometric indices, PFT, Rural and urban adolescents, Spirometry.

Introduction

Various methods are employed to assess different lung function parameters and they include peak flow meters, spirometry, flow volume loop, plethysmography, gas dilution etc. Spirometry is the method of choice for evaluation of pulmonary function test. Theoretically, all the parameters can be studied to assess pulmonary function. However, in clinical practice, neither all parameters can be easily estimated nor it is necessary to evaluate all for the diagnosis and management of most of the diseases. Spirometer measures FEV1(forced expiratory volume in first second), FVC (Forced vital capacity) and FEF25-75% (forced expiratory flow during 25-75% of expiration); these parameters serve the purpose in almost all the clinical conditions preferably in children (Amdekar et al 1996).

Pulmonary function tests (PFTs) are an essential part of the investigation of many respiratory diseases. With wide availability of simple to operate pulmonary function equipment, these tests can now be performed in any settings. Though they do not provide a specific diagnosis, they help us to understand the physiologic and functional abnormalities and to follow the course of the disease. Pulmonary function tests provide an objective measure of pulmonary disability and should be used routinely in the management of children with chronic respiratory diseases.

The objective of the present study was to assess pulmonary functions of urban and rural adolescent population, both boys and girls, in Barabanki district, Uttar Pradesh, India.

Materials And Methods

It was an exploratory and observational study conducted at Department of Physiology, Hind Institute of Medical Sciences (HIMS), Safedabad, Barabanki, U.P., India. The rural and urban areas adjoining HIMS were also included in the study. Duration was of around two years.

The study group consisted of 450 healthy urban and rural adolescent population (218 and 232 healthy urban and rural adolescent boys and girls, respectively.) with normal respiratory capability belonging to age group 10–19 years. Participants had no history of any chronic illness, congenital and neurocognitive deficit.

The approval for this study was taken from Institutional Ethical Committee.

Methodology

Complete physical examination, particularly for respiratory and cardiac system was done. Their age, height and weight were recorded. Pulmonary function tests were carried out in the morning after breakfast. The tests were carried out in sitting position. Each subjects had to attend one session.

Before commencement of the study, written informed consent was obtained from parents of all the subjects. Individuals with structural deformity of thoracic cage– scoliosis, kyphosis etc., major medical illnesses, evidence of grossly enlarged tonsils and adenoids, acute upper and lower respiratory tract infections within 10 days of study, chronic respiratory diseases like – chronic bronchitis, bronchial asthma etc., allergic diseases,

cardiac diseases, anemia, smokers, having family history of asthma in first degree relatives were excluded.

Procedures

Evaluation of Pulmonary Functions

A proforma (App. No.-1) were given to all the Subjects for getting their family history as well as for parental consent. Informed consent was also obtained from school principal. The procedure to be performed was explained in the local language to each and every child. Complete physical examination, particularly for respiratory and cardiac system were done. Their age, height and weight were recorded. Age was taken from the date of birth recorded in school register. Height and weight both were taken without shoes. While weight was recorded on a standard regularly calibrated weighing machine. The height was recorded against a wall with calibrated tape in standing position with feet closed to each other, the head and back of the body touching the wall, as described above. Pulmonary function tests were carried out in the morning after breakfast. The tests were carried out in sitting position.

The machine used for doing the pulmonary function tests was a computerized spirometer Spirolab-II. It is a high-performance instrument capable of giving highly accurate, repeatable tests results and represents a major advancement in computerized pulmonary function testing.

Position of the subjects and testing procedure

- Tight clothings and waist belt were loosened.
- Subject was seated comfortably.
- A nose clip was applied to close the nostrils.
- The subject was instructed to take the maximum possible inspiration, as much as they could.
- Keep the mouth piece over tongue, so that it does not obstruct the mouth piece. Then close the lips around the mouth piece tightly.
- Mouth piece used was of mono use disposable type with external diameter of 30 mm.
- Then blow out all the air into the mouth piece as rapidly, forcibly and completely as possible, with the maximum possible effort.

The subjects were made to practice this manoeuver for five minutes before actually performing on the machine. This procedure is repeated on the machine till three reproducible results re elicited and the most consistent one was noted.

Statistical analysis

Overall effect of age, height and weight on these lung function test variables (FVC, FEV1, PEFR, FEF25-75%) were tested by applying analysis of variance, separately for urban and rural adolescent boys and girls.

Correlations were calculated between the study variables and the physical characteristics (Age, height and weight) separately for boys and girls. Their significance was tested by applying “t” test. All the study variables were thereafter regressed over age, height and weight separately for boys and girls. All possible combinations of regressor (independent) variables of age, height and weight were considered to propose prediction equations.

Results

In our study the maximum number of boys and girls were of age group of 15 yrs. The maximum number of boys are in height range 150-159 cm. and the maximum number of girls are in height range 140-149 cm.

Table 1: Height distribution of male and female children

Height	Male		Female	
	No.	%	No.	%
120-129	26	10.61	36	17.56
130-139	60	24.49	42	20.49
140-149	62	25.31	64	31.22
150-159	71	28.98	47	22.93
>=160	26	10.61	16	7.80
Total	245	100.0	205	100.0

Table-1 shows the height distribution of total male and female children.

Table 2: Mean ± SD of age, height and weight of male and female children

Variables	Male (n = 245)	Female (n = 205)
AGE	13.02±2.15	13.28±2.24
HEIGHT	143.4±10.32	139.32±11.42
WEIGHT	32.40±6.28	35.22±7.08

The table-2 shows the mean age, height and weight of 245 male and 205 female children.

The mean height of the girls was less than boys of same age except 14 and 15 yrs. The mean weight of girls was higher in comparison to boys for 10-17 yrs.

Table 3: Lung function tests in Rural Boys and Urban Boys

Lung function test parameters	Rural Boys		Urban Boys		t-test (p-value)
	No.	Mean ± SD	No.	Mean ± SD	
FVC (L)	128	2.20±0.43	117	2.10±0.41	3.09 (p=0.002)*
FEV1 (L)	128	1.94±0.32	117	1.88±0.38	0.74 (p=0.44)
PEFR (L/sec.)	128	4.89±1.05	117	4.56±1.07	2.43 (p=0.01)*
FEF25-75% (L/sec.)	128	2.62±0.51	117	2.59±0.54	0.19 (p=0.84)

Table 3 shows lung function tests of rural and urban boys.

Table 4: Lung function tests in Rural Girls and Urban Girls

Lung function test parameters	Rural Girls		Urban Girls		t-test (p-value)
	No.	Mean ± SD	No.	Mean ± SD	
FVC (L)	104	2.06±0.42	101	2.04±0.39	2.92 (p=0.002)*
FEV1 (L)	104	1.92±0.43	101	1.82±0.41	0.68 (p=0.44)
PEFR (L/sec.)	104	4.69±1.08	101	4.62±1.06	2.31 (p=0.01)*
FEF25-75% (L/sec.)	104	2.66±0.54	101	2.59±0.52	0.18 (p=0.84)

Table 4 shows lung function tests of rural and urban girls.

FVC level of boys were significantly higher (P<0.01) than girls. FEV_1 were also higher in boys than girls though it was not statistically significant (P>0.05). The levels of $FEF_{25-75\%}$ were also higher in boys than girls, though it was not statistically significant (P>0.05). The levels of PEFR were significantly higher (P<0.05) in boys and girls.

The study of PFT values (FVC, FEV_1, PEFR, $FEF_{25-75\%}$) were found to be higher in rural areas than urban areas for both adolescents Boys and Girls.

Table 5: Correlation coefficients of age, height and weight with lung function tests in boys

Lung function test parameters	Correlation coefficients		
	Age	Height	Weight
FVC (L)	0.92*	0.97*	0.96*
FEV1	0.94*	0.98*	0.95*
PEFR (L/sec.)	0.91*	0.95*	0.94*
FEF25-75% (L/sec.)	0.96*	0.98*	0.98*

*Significant (p<0.001)

The Table-5 shows the correlation with age, height and weight of boys with the various parameters of lung function test (FVC, FEV1, PEFR, FEF25-75%). These parameters of lung function test were highly correlated with the age, height and weight of boys. All the correlations were highly significant, p<0.001). In general, maximum correlation was observed in relation to height followed by weight and age.

Table 6: Correlation coefficients of age, height and weight with lung function tests in girls

Lung function test parameters	Correlation coefficients		
	Age	Height	Weight
FVC (L)	0.94*	0.90*	0.96*
FEV1	0.95*	0.91*	0.97*
PEFR (L/sec.)	0.96*	0.92*	0.96*
FEF25-75% (L/sec.)	0.97*	0.93*	0.98*

*Significant (p<0.001)

The Table-6 shows the correlation with age, height and weight of girls with the various parameters of lung function test (FVC, FEV1, PEFR, FEF25-75%). These parameters of lung function test were highly correlated with the age, height and weight of girls. All the correlations were highly significant, p<0.001). In general, maximum correlation was observed in relation to weight followed by height and age.

The mean value of different parameters of lung function shows positive linear correlation with height i.e., lung parameters increase with increase in height i.e., significantly associated with height of both boys and girls (P<0.001). The mean value of PFT show positive linear correlation with age for both boys and girls significantly associated (P<0.001). The mean value of PFT shows positive linear correlation with weight of both boys and girls and significantly associated (P<0.05) but were less significant than height and age.

PFT significantly correlated with Age, Height and Weight of both Boys and Girls (P<0.001). Maximum correlation in general was observed in relation to Height followed by Weight and Age in Boys. Maximum correlation in general was observed in relation to Weight followed by Height and Age in Girls.

Table 7: Regression equation to predict various lung function test parameters in boys based on height, weight and age

Lung function test parameters	Correlation coefficients			Constant
	Age	Height	Weight	
FVC (L)	0.028	0.019	0.025	-2.365
FEV1	0.025	0.019	0.012	-2.270
PEFR (L/sec.)	0.069	0.016	0.135	-5.863
FEF25-75% (L/sec.)	0.029	0.012	0.062	-2.038

*p<0.01 (Significant)

In the Table-7 stepwise regression was performed by pitting lung function test parameters (FVC, FEV1, PEFR, FEF25-75%) as dependent variables and height, weight and age as independent variables for healthy boys. In the stepwise regression height was the most important independent variable. But the regression coefficient for weight was also significant. In boys age did not make any significant additional contribution.

Predicted values can be derived from these equations as follows:-

Predicted value = constant + standing height in cm * height coefficient + weight in kg * weight coefficient.

Table 8: Regression equation to predict various lung function test parameters in girls based on height, weight and age

Lung function test parameters	Correlation coefficients			Constant
	Age	Height	Weight	
FVC (L)	0.016	0.025	0.024	-1.315

FEV1	0.018	0.020	0.010	-1.530
PEFR (L/sec.)	0.027	0.026	0.125	-2.317
FEF25-75% (L/sec.)	0.028	0.010	0.057	-2.279

*p<0.01 (Significant)

In the Table-8 stepwise regression was performed by pitting lung function test parameters (FVC, FEV1, PEFR, FEF25-75%) as dependent variables and height, weight and age as independent variables for healthy girls. In the stepwise regression height was the most important independent variable for FVC, FEV1. In girls age made a significant additional contribution.

Predicted values can be derived from these equations as follows:-

Predicted value = constant + standing height in cm * height coefficient + weight in kg * weight coefficient + age in year * age coefficient.

Stepwise regression for PFT and dependent variables and Height, Weight and Age and independent variables for healthy Boys and Girls shows Height as most independent variable along with Weight in boys and Age in Girls.

Table 9: Predicted values of pulmonary function test parameters among boys and girls in present study.

pulmonary function test parameters	Boys of specific age (10 years), height (150 cm.) and weight (40 kg)	Girls of specific age (10 years), height (140 cm.) and weight (35 kg)
FVC(L)	2.36	2.13
FEV_1	2.08	1.87
PEFR (L/SEC.)	5.17	4.84
$FEF_{25-75\%}$ (L/SEC.)	2.69	2.77

In the Table-9 we have compared our predicted values of pulmonary function test parameters among boys and girls at specific age, height and weight and found to be greater in boys than girls.

Discussion

Ethnic variations (Miller et al 1970), physical activity, environmental conditions and altitude of dwelling (Cotes et al 1966), tobacco smoking (Ferris et al 1965 & Pelzer et al 1964) and changes in the age, height, sex and socio-economic status (Kamat et al 1982 &Milledge 1965) can affect normal values of pulmonary function. India is a subcontinent with varying geography and with a large multiethnic population. Regional differences in lung functions in healthy Indians can thus be expected. Therefore, in order to have accurate prediction formulae for measurements of lung function, pulmonary function studies should be carried out in a large group of healthy subjects residing in various parts of India.

A number of pulmonary function studies, mainly of ventilator parameters in adults had been published in India. (Vijayan et al 1990, Kamat et al 1982, Milledge 1965, Kamat et al 1967 & Singh et al 1970).

There are not many studies in North Indian children especially U.P. to predict pulmonary functions of rural and urban adolescents. The purpose of study was to derive normal standards of PFT of adolescent age (10-19 years) residing in Barabanki and its adjoining areas and to calculate regression equation.

The PFT finding of our studies showed that the values were higher in rural areas than urban areas for both boys and girls.

There is increase in height of both boys and girls with growth which is similar to earlier studies and have linear relationship between PFT and anthropometric measurements (Age, Height and Weight). In the same age group boys have greater PFT values than girls due to their better physical health and performance.

The PFT findings is better in rural adolescents than their urban counterparts probably due to better environmental factors and less pollution.

Our study shows the values nearer to South Indian and Western children but lesser than Caucasians.

Conclusion

- PFT values were significantly associated with an increase in Height and Weight in both boys and girls according to their growth.
- There is a linear relationship between physical characteristic viz, Age, Height and Weight with PFT.
- The mean value of different parameters of lung function shows positive linear correlation with height i.e., lung parameters increase with increase in height. It is significantly associated with Height of both boys and girls ($P<0.001$).
- The mean value of PFT show positive linear correlation with Age for both boys and girls significantly associated ($P<0.001$).
- The mean value of PFT show positive linear correlation with Weight of both boys and girls and significantly associated ($P<0.05$) but were less significant than Height and Age.
- The study of PFT values (FVC, FEV_1, PEFR, $FEF_{25-75\%)}$ were found to be higher in rural areas than urban areas for both adolescent boys and girls.
- The PFT finding of our studies showed that the values were higher in lower socio-economic adolescent population for both boys and girls.
- Our study establishes normal standards of PFT for adolescent population (10-19 years) residing in Barabanki and its adjoining areas.

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