Article

FEV_1, FVC, FEV_1/FVC ratio in children of 7-14 years of age from Western Rajasthan

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Abstract

Background: The knowledge of pulmonary function tests (PFTs) is a basic requirement to understand the respiratory physiology for all medical physiologists and clinicians Pulmonary Function Tests provide objective evidence of nature and severity of lung disease. **Objective:** To observe FEV_1, FVC, FEV_1/FVC ratio in healthy male and female school children from 7-14 years of age in Western Rajasthan and to find out the relationship of FEV1, FVC, FEV1/FVC ratio with their height, weight, BSA and sex **Methods**: The present study was carried out on 112 male and 76 female children of 7-14 years. For Pulmonary Function Tests, FEV1, FVC and FEV1/FVC along with anthropometric data of each subject was recorded.. Data were analyzed by unpaired t test, Pearson correlation coefficient test, simple and multiple regression analysis. **Results:** FVC and FEV1 values were found significantly ($p<0.001$) higher in male than those of female. Significant positive correlation of FVC and FEV1 whereas non significant negative correlation of FEV1/FVC were observed with age, height, weight, body surface area in all children. **Conclusion:** As the weight, age, height and BSA of subjects increases, FEV1 and FVC increases while FEV1/FVC ratio decreases in both the sexes.

Keywords: Pulmonary Function Tests, FEV1, FVC, FEV1/FVC Ratio and anthropometric

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Introduction

The knowledge of pulmonary function tests (PFTs) is a basic requirement to understand the respiratory physiology for all medical physiologists and clinician. Since the PFTs are affected in one way or the other in most of the pulmonary diseases, clinicians must know the PFTs for correct diagnosis.[1] FVC is the maximum volume of air exhaled with maximally forced expiratory effort as rapidly as possible. FEV1 is volume of air exhaled during first seconds of FVC expressed in liters. Spirometry is simple, noninvasive technique used to monitor clinically significant changes in lung functions. The normograms available for paediatric patients in medical literature are mostly from the western countries hence cannot be applied to Indian children due to racial, ethnic and environmental factors.[2.] Few studies have been conducted by Indian workers to establish norms of PFTs in healthy children from various parts of India and these studies do not serve the purpose well.[3-5] Ideally speaking all states and geographical regions as well as communities must have their separate norms for PFTs.. PFTs are dependent on many social and physical factors including sex, race, altitude and body surface area of an

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individuals. As PFTs provide objective evidence of nature and severity of lung disease[1], the present study was undertaken to establish the norms of FEV1, FVC, FEV1/FVC ratio in healthy school children from 7-14 years of age in Western Rajasthan, India and to find out relationship of FEV1, FVC, FEV1/FVC ratio with height, weight, BSA and sex of children if any.

Methods

This cross-sectional study was originally designed to conduct on 223 apparently healthy school going children from age group 7-14 years, student of Maheshwari public school, Siwanchi gate, Jodhpur. 35 children (19 male and 16 female) were excluded from the study because they did not fulfill the inclusion criteria. Finally 188 children (112 male and 76 female) were included in the study. The study was conducted in the department of paediatrics, Regional Institute of Maternal and Child health, attached to Dr S.N. Medical college Jodhpur. Institutional ethical committee approved the protocol and informed written consent was obtained from parents of the enrolled children. A preliminary clinical evaluation was done with the help of history, general physical examination and systemic examination in all children. On the basis of history, children with history of asthma or wheezy bronchitis, hay fever and other allergies, family history (first degree relatives) of asthma and atopy, cold within previous two weeks and history of acute or chronic cardiopulmonary disease during last six months were excluded.

The age of the subjects was recorded in completed year. Standard heights were measured in cms. The height nearest to 0.1cm and weight nearest to 0.1 kg with minimal clothing were measured using the height and weight scale. FEV1, FVC, FEV1/FVC ratio were measured by Vitalograph Compact Spirometer. The whole procedure was explained as well as demonstrated to each child .The mouth piece was placed in the child's mouth in such a manner that effective air seal obtained with lips and no obstruction is caused by tongue or teeth. These tests were performed on the basis of the guidelines laid down by American Thoracic Society. Best of three recordings was taken as the observation. Body surface area of the children was calculated using following formula.[6]

$$A = W^{0.425} \times H^{0.725} \times 71.84$$

Where A=Surface Area in cm^2, W= Weight in kg, H= Height in cm

The data were expressed as mean + SD. For statistical analysis, unpaired t test, Pearson's correlation coefficient test was used. In addition prediction equations for FEV1, FVC, and FEV1/FVC ratio were obtained by using simple and multiple regression analysis of anthropometric variables such as age, weight, height and body surface area.

Results

Among the 188 healthy school children participated in this study, 112(59.57%) children were male and 76 (40.42%) were female. The male female ratio was 1.47:1. There was no significant differences between sex in respect of age, weight, height and BSA (Table-I).

Table I : Mean age, weight, height and body surface area(BSA) of both male and female

Variables	Male (n=112)	Female (n=76)	P values
Age (years)	10.68	10.37	p>0.05
Weight (kg)	33.04	31.59	p>0.05
Height (cm)	132.37	125.09	p>0.05
BSA	1.26	1.03	p>0.05

Although, there was significant difference ($p<0.001$) in mean FEV1 and FVC between male and female but FEV1/ FVC was almost similar (>0.05). (Table II).

Table II : Pulmonary Function Tests parameters in both sexes (n=188)

Variables	Male (n=112)	Female (n=76)	P value
FEV1(L)	1.73±0.21	1.48±0.34	<0.001
FVC (L)	2.06±0.33	1.76±0.47	<0.001
FEV1/FVC	85.52±1.46	85.48±1.63	>0.05

Data is expressed as mean ± SD .Statistical significance was analyzed by Unpaired 't' Test

Correlation analysis of PFTs parameters with anthropometric variable showed significant, positive correlation of FEV1 and FVC but negative correlation of FEV1/ FVC though not significant with age, height, weight, BSA(Table III &IV).

Table III : Correlation Coefficient of PFTs with Anthropometric Variable in male

Variables	Age	Height	Weight	BSA
FEV1	0.54	0.57	0.76	0.78
FVC	0.69	0.74	0.76	0.78
FEV1/FVC	-0.19	-0.26	-0.33	-0.33

Table IV: Correlation Coefficient of PFTs with Anthropometric Variable in females

Variables	Age	Height	Weight	BSA
FEV1	0.34	0.49	0.4	0.43
FVC	0.47	0.62	0.58	0.60
FEV1/FVC	-0.28	-0.28	-0.35	-0.34

Results of regression analysis of PFTs with age and other anthropometric parameters showed that as the weight, age height and BSA of subjects increase, FEV1 and FVC also increase while FEV1/FVC ratio decreases in both the sex. (Table V&VI)

Table V: Regression Coefficient of FEV1, FVC & FEV1/FVC and age

Variables	Male		Female	
	K1	A1	K2	A2
FEV1	0.16	0.15	0.67	0.08
FVC	-0.45	0.24	0.41	0.14
FEV1/FVC	101.75	-1.57	104.62	-1.79

Table VI: Regression Coefficient of FEV1, FVC & FEV1/FVC and anthropometric Variable

PETs	Height				Weight				BSA			
	Male		Female		Male		Female		Male		Female	
	K1	A1	K2	A2	K1	A1	K2	A2	K1	A1	K2	A2
FEV1	-1.65	0.02	-0.96	.02	0.61	.04	0.9	.02	0.35	1.34	0.70	0.74
FVC	-3.35	0.04	-1.77	.03	0.22	.06	0.8	.03	-0.21	2.21	0.56	1.18
FEV1/FVC	130.96	-0.32	122.5	-.28	104.3	-0.6	99.9	-43	108.0	-22	102.5	16.3

K1: Constant for male, K2: Constant for female A1: Coefficient of variable for male, A2: Coefficient of variable for female.

Function Y= K1+Variable(Age/ weight/ Height/BSA) x A1(for male)

Function Y= K2+Variable(Age/ weight/ Height/BSA) x A2(for female)

Discussion

The purpose of this study was to find out the mean values for PFTs as per the age and sex. The mean FVC values for all the ages and both the sex were found higher in the present study in comparison to the results of Deshpandy et al.[7], Rahman et al.[8], Chaterjee and Mandal[9]. Lower mean values were observed in these studies could be due to geographic and ethnic variations. Higher value of FVC was observed by Sharma et al[6] could be due to difference in the socioeconomic status of the subjects enrolled. Maximum value of the correlation coefficient for FVC was seen with BSA followed by height and age among male children. For female, hightest. correlation was seen for height then followed by BSA, weight and age. Comparable correlation for FVC in male and female children was observed by Kumar et al[10] and Deshpandy et al[7]

Regression coefficient revealed good positive linear correlation for FVC with age, weight, height and BSA . Kumar A. et al[10], Rahman et al[8] and Sharma et al[6] also mentioned almost similar observations in their regression analysis.

Present study revealed that FEV1 increases with the increase in age, weight, height and BSA of the study subjects. Again FEV1 observations for male were higher than their counterparts. Malik and Jindal[2] reported almost the same results. Whereas Pandey et al [11] Sharma et al[6] reported lower values for FEV1 for both sex than the present study. Statistically significant correlation coefficients were observed for all the four independent variable with FEV1. Singh et al[12], Sharma et al[6], Pandey et al. [11]and Deshpandy et al[7] also observed good correlation coefficient for age, weight, height and BSA. The Correlation coefficient values computed by Chetty et al[13] and Godfrey et al [14]are very close to the results of this study. Using the regression equations for FEV1 with the parameters like age, height, weight, and BSA it was found that values were higher than reports by Singh et al. [12], Deshpanday et al.[7], Rahman et al.[8], Chaterjee and Mandal [9] and Sharma et al.[6].This variations are probably due to ethnic and stature variation of the enrolled subjects.

In the present study, it was observed that there was a fall in mean value of FEV1/FVC with the increase in anthropometric parameters. While Rahman et al [8] had shown a positive correlation of this ratio with age and Sharma et al[6] had quoted this ratio independent of age. The correlation coefficient were found to be statistically significant for age and height and highly significant for weight and BSA. The values of correlation coefficient were not in agreement with the observations made by Kumar et al [10] and Sharma et al[6]. Mean values of FEV1 were comparable with Rahman et al[8].

Sharma et al[6] in their study had made attempts to get prediction equation for FEV1/FVC but the values of regression coefficient were found to be zero for age, height and weight. So they reported that the ratio was independent of age, weight and height in children of their study. The results of Khudson et al[15] in their regression equation show a similar pattern as in present study who observed that this ratio tends to decrease consistently with the age. This is in agreement with observations of present study.

Conclusion

The present result concludes that gender based difference in pulmonary function being higher in male than female children in this age group are present. In addition, values of FEV1 and FVC increases FEV1/FVC decreases with increase in age, height, weight, BSA in both male and female.

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