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Pulmonary Function Test in Healthy Schoolchildren of 7 to 15 years age in North Kerala

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Abstract
Background: *Among the various investigation modalities available, pulmonary function test (PFT) is an invaluable tool for the assessment of lung function. PFT values are influenced by race .age, sex, height, weight as well as environmental, genetic, socio-ecnomocal and technical parameters.*
Objective: *To determine pulmonary functions in the age group 7-15 years and to find its correlation with regards to age, sex, height, weight and body mass index.*
Materials and Methods: This study was conducted among normal healthy school children of kannur aged 7 to 15 years . With preformed questionnaire children were interviewed, children with previous history of asthma and other chronic lung diseases were excluded, detailed general physical and systemic examination was done. Height, weight, body mass index were measured. All included children were tested in a sitting position with the head straight after taking written consent from parents. Spirometry was done using Micromedical Gold standard fully computerized portable auto spirometer (Superspiro Cat No. SU 6000). Statistical analysis of the data was done with SPSSv24.
Results: *There were 166 children 111 boys and55 girls. Minimum FVC WAS 1.20L and maximum FVC was 3.80lMinimum FEV1was1.07 and maximum FEV1 was3.02l. FVC, FEV 1 and PEFR were found to be statistically significant in the study groups. For FVC and FEV 1, highest correlation was found with height and weight in both boys and girls. PEFR showed weak correlation with weight in boys*
Conclusion: *Variables such as FVC, FEV 1 show good positive correlation with height, age and body mass index in both sexes. There is a need to have regional values for the prediction of normal spirometric parameters in a country like India with considerable diversity.*
Keywords: *Pulmonary Function Test, Forced Vital Capacity, Peak Expiratory Flow Rate (PEFR).*

Introduction

Pulmonary function test (PFT) is an invaluable tool for the assessment of lung function. PFT for lungs can be comparable to the ECG for heart[1]. Pulmonary function test (PFTs) are considered as an essential component for evaluation of lung functions, to identify the underlying cause of respiratory symptoms in children and adolescents & monitor the status of those with chronic lung diseases.PFT values are influenced by race age, sex, height, weight, environmental, genetic, socio-economical and technical parameters. Predictive

normal values are essential for meaningful clinical interpretation of these tests. Studies carried out in children had projected the equations for predicting different lung functions using height, age and weight as independent variables in India[2–5] and in other countries[6,7]. From these studies, it is obvious that there are differences in spirometric parameters between Indian and western world as well as regional differences. There are only a few studies that have established reference standards for pulmonary function of Indian children.[2,8,9,10] However, more than 120 reference standards are published for pulmonary function in white children[11,12,13]. The prevalence of childhood pulmonary diseases especially bronchial asthma is increasing worldwide[14] and this necessitates the need for establishing regression equations for predicting pulmonary functions in children. Reference standards for pulmonary function that are reported for Indian children are mainly from northern and western parts of the country[2,8,9,10] and there is a paucity of data on pulmonary function in normal South Indian children. Pulmonary function is known to vary with age, sex, height, weight, race and geographic locations[15,16]. India, being a subcontinent, changes in pulmonary functions can occur between children of South Indian origin and children of other regions[11,12,13]. So, the present study was conducted with a purpose to obtain reference values for forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), forced expiratory volume ratio in one second (FEV_1%) and peak expiratory flow rate (PEFR) among children aged 7-15 years in NORTH KERALA.

Objectives

1. To study and evaluate the pulmonary functions in healthy school children of 7 to 15 years age in north Kerala.
2. To find its correlation with regards to age, sex, height, and weight and body mass index.

Methodology

This cross-sectional study was conducted in the Department of Respiratory medicine, Pariyaram medical college, Kannur, Kerala. The study was conducted among normal healthy school children of 7-15 years in KANNUR. Children with history of any febrile illness in last 2 weeks, upper respiratory tract infections (URTI) like symptoms in past 2 weeks, acute or chronic respiratory diseases, any major systemic disease like cardiac or renal problems, clinically significant anemia, h/o any drug intake which can affect PFT, h/o any allergy, children with bone deformity of chest or spine and any muscular weakness, family history of atopy, asthma or other chronic lung diseases ,those who are unable to perform the Spirometry and those who are not willing to participate in the study were excluded from the study. The prior permission of school authorities was taken and written consent from the parents of the students involved in the study obtained. The purpose and objective of the study was explained to school authorities and parents. A detailed proforma was filled by asking parents of children, and a thorough clinical examination on each child was done to rule out any significant problems fitting the exclusion criteria. Both height and weight will be recorded. Spirometry was done using Micromedical Gold standard fully computerized portable auto spirometer (Superspiro Cat No. SU 6000). All included children was tested in a sitting position with the head straight. Before testing, the procedure was explained and demonstrated to each child. Each child was told to take a deep breath and then blow into the mouth piece as hard and fast as he/she could. At least three trials were given and best of the three was chosen for analysis, based on standardization of spirometry study based on ATS/ERS task force series[17] and various other studies.[2–5,7,18] The same spirometer was used throughout the study and the tests was performed by the same technician. The main spirometric parameters were measured and displayed and all data with flow-volume and volume-time curves were printed out by built-in

thermal printer. The device uses a turbine sensor and a mouth piece required to connect a subject to the spirometer. A new disposable mouth piece was used every time in a new candidate. PEFR was measured by Wright's peak flow meter.

Analysis

Data were analysed with Spssv24.Data were described as mean+/-SD. Student t test and chi-square test were used for analysing within the group. Multiple linear regression analysis also used.

Ethical clearance: The study was approved by institutional ethical and research committee.

Results

Total 166 participants, 111 boys and 55 girls. In the study group 19 (11.44%) students gave history of passive smoking and 15(9.05%) gave history of biomass fuel exposure

Table-1 Anthropometric and lung function variables of study group as per mean ± SD

CHARECTERISTICS	MINIMUM	MAXIMUM	MEAN	STD DEVIATION
AGE (YRS)	7.00	15.00	12.43	1.24
HEIGHT (CM)	123.00	168.00	148.69	9.18
WEIGHT (KG)	18.00	68.00	39.57	8.26
BMI	10.91	25.00	17.78	2.94
FVC(L)	1.20	3.80	2.26	0.41
FEV1(L)	1.07	3.02	1.98	0.36
PEFR	198.30	753.00	299.93	71.69

Table 2 Sex wise correlation

	SEX	N	Mean	Std. Deviation	p value*
AGE	Female	55	12.45	1.00	0.845
	Male	111	12.41	1.34	
HEIGHT	Female	55	147.64	9.05	0.298
	Male	111	149.22	9.24	
WEIGHT	Female	55	38.53	6.82	0.255
	Male	111	40.08	8.87	
BMI	Female	55	17.63	2.57	0.648
	Male	111	17.85	3.12	
FVC(L)	Female	55	2.17	0.32	0.063
	Male	111	2.30	0.45	
FEV1(L)	Female	55	1.91	0.33	0.069
	Male	111	2.01	0.37	
FEV1/FVC(%	Female	55	87.96	5.07	0.501
	Male	111	87.05	9.25	
PEF(L/mi)	Female	55	269.03	52.12	<0.001
	Male	111	315.25	75.24	

*Using Student's t test for independent means

FVC, FEV 1 and PEFR were found to be statistically significant in the study groups. For FVC and FEV 1, highest correlation was found with height and weight in both boys and girls. PEFR showed weak correlation with weight in boys.

Correlation between various Anthropometric and Lung Function Variables in Study Group

Table-3 Correlation between various Anthropometric and FVC

FVC	Correlation Coefficient	P Value
Age	0.617	<0.001
Height	0.891	<0.001
Weight	0.717	<0.001
BMI	0.233	<0.002

Table 4 Correlation between various anthropometric and FEV1

FEV1(L)	Correlation Coefficient	P Value
Age	0.553	<0.001
Height	0.839	<0.001
Weight	0.738	<0.001
BMI	0.31	<0.001

Table-5 Correlation between various anthropometric FEV1/FVC

FEV1/FVC(%)	Correlation Coefficient	P Value
Age	0.041	0.596
Height	0.058	0.457
Weight	0.055	0.478
BMI	0.033	0.674

Table-6 Correlation between various anthropometric and PEFR

PEFR	Correlation Coefficient	P Value
Age	0.08	0.308
Height	0.163	0.036
Weight	0.27	<0.001
BMI	0.206	0.008

Discussion

In India, several studies were carried out on school children to predict the lung function using anthropometric variables. The present study has shown significant correlation for FVC with age, weight and height (p value <0.001). Similarly, for FEV_1 significant correlation was found with age, weight and height (p value <0.001) which was also reported by various authors.[9,19,20] Shamssain *et al*,[21] in their study in Libyan children showed that FVC (r=0.442, *P*<0.001) and FEV_1 (r=0.479, *P*<0.001) were significantly less in girls than boys. Vijayan *et al*,[22] in a study on south Indian children, showed that correlations of FVC and FEV_1 were highest with height followed by weight and age. Height influences the prediction equations in males to a greater extent

whereas age and weight had greater influences in girls. Wang *et al*,[23] concluded that for the same height boys, have greater lung function values than girls. Similarly for PEF significant correlation was found only with weight. All the pulmonary variables were slightly higher side in males but only PEF was at a significant higher side (p value <0.001). A significant positive correlation was observed between FVC, FEV1, PEFR and all the anthropometric indices. Table 7 shows a comparative study of various variables in boys and girls with other studies.

Table 7 Comparison of FVC, FEV1 and PEFR among boys and girls with other studies

Author	No. of cases	PEFR	FVC	FEV_1
For boys				
Tahera H. doctor et al[26](south Gujarat region, India)	408	4.74±0.96	2.01±0.46	1.76±0.38
Sharma PP *et al* (Delhi)	222	4.21±0.76 (0.000)	2.13±0.5 (0.0019)	2.05±0.41 (0.000)
Mallik SK *et al* (North India)	441	-	2.1±0.7 (0.023)	1.9±0.6 (0.00048)
Harikumaran NR (South India)	109		1.77±0.21 (0.0001)	1.59±0.19 (0.0001)
Present study	111	3.1525±0.75	2.30±0.45	2.01±0.37
For girls				
Sharma PP *et al* (Delhi)	188	4.01±0.88 (0.00067)	1.82±0.41 (0.023)	1.73±0.43 (0.296)
Mallik SK *et al* (North India)	322	-	1.9±0.4 (0.765)	1.7±0.8 (0.829)
Tahera H. doctor et al(south Gujarat region, India)	247	4.47±1.15 4.47±1.15	1.910±0.47 1.910±0.47	1.688±0.40 1.910±0.47 1.688±0.403 1.688±0.403 1.688±0.403
Present study	55	2.6903±0.52	2.17±0.35	1.91±33

The lung function reported from India and other parts of south Asia exhibit considerable diversity. Contributory factors are racial differences, use of a wide variety of equipments and numerous environmental influences including nutrition, climate, terrain and prevalence of diseases(24). In India, several studies were carried out on school children to predict the lung function using anthropometric variables. The studies conducted on children at Chandigarh,[2] Bombay,[3] Delhi[4] and Hyderabad 36 have projected different types of regression equations for lung functions in Indian children. Some of them had used age, height and weight,[4] age and height,[5] age and body surface area[2] or height alone[25] as independent variables for prediction of lung functions.

Vijayan *et al*,[22] in a study on south Indian children, showed that correlations of FVC and FEV_1 were highest with height followed by weight and age. Height influences the prediction equations in males to a greater extent whereas age and weight had greater influences in girls. Wang *et al*,[23] concluded that for the same height boys, have greater lung function values than girls. FEV_1% has shown negative correlation with height and age while statistically significant positive correlations with surface area, similar to Shamssain study.(7)

Conclusion

Variables such as FVC, FEV 1 show good positive correlation with height, age and body mass index in both sexes. There is a need to have regional values for the prediction of normal spirometric parameters in a country like India with considerable diversity.

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