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PFT Prediction Equations in Rural and Urban School Children: Need for Separate Equations.

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ABSTRACT

Pulmonary Function Test is very useful and important tool for diagnosis, assessment of respiratory system's functional status. For this purpose there was need of deriving prediction equations for evaluation and under-standing of the Pulmonary Function Test parameters. Present study highlights prediction equation for Pulmonary Function Test parameters among rural and urban school children. Total 440 school children (220 rural & 220 urban) were subjected to measurement of anthropometric and Pulmonary Function Test parameters. Pulmonary Function Test assessment done with MIR SPIROLAB II. The data was analysed using biostatic software SPSS ver 16. Present study observed better correlation between different anthropometric parameters like age, height, weight, arm span and Body Surface Area with Pulmonary Function Test parameters like Forced Vital Capacity, Forced Expiratory Volume in one second and Peak Expiratory Flow Rate in both rural and urban children..Also it derived prediction equation in both rural and urban school children. Not only significantly different anthropometric parameters predict Pulmonary Function Test in rural and urban children but also different prediction equations were derived from this study.

INTRODUCTION

There is established role of PFT in diagnosis of lung diseases. It is also useful in assessing growth and maturity of lung function which goes side by side with somatic growth. With advancement of somatic growth there is linear increase in pulmonary function.[1] For diagnosis and evaluation for PFT parameters there was need for population specific prediction equations when ethnicity, race, social ,economic factors were taken into account.[2] Various studies in India and in other countries have shown that there are different independent variables which affect lung functions in school children. Large number of studies[3,4] have shown that PFT norms in Indian children are different from those in western and other countries as well as there are regional variations in PFT values[5] In present study we have tried to find out which anthropometric factor affect lung function up to maximum extent in rural and urban school children rather than school children as whole group in central India. Are these anthropometric factors different in rural and urban children ?Also we derived prediction equations for PFT parameters using the independent factors like age, height, weight, arm span, Body surface area. Our study tries to find out which factors among these best correlates with lung function in both these groups.

MATERIALS AND METHODS

Present study was carried out on 220 urban school children(110 boys and 110 girls) from Nagpur city and same number of rural school children from village situated 80 kms away from Nagpur city. Study protocol was approved from IEC of GMC Nagpur. The study was conducted in Oct-07 to Jan-08.Informed consent was taken from parents of the students and school authorities after explaining the purpose & objective of study.

Inclusion & exclusion criteria of study subjects are given below.

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Inclusion criteria:

- All children in age group of 5-15 years.
- Absence of chronic airway disease.
- No history of ARI.
- No major respiratory disease or thoracic surgery in past.
- No systemic disease influencing the respiratory system.
- Children with no thoracic wall & spinal deformity.
- Non smokers.

Exclusion criteria

Subject less than 5years or more than 15 years.

- History of thoracic cage disorders, chest deformity which could affect the pulmonary function.
- Past or present history of respiratory disease, cardio respiratory illness.

The detailed history regarding present and past illness was taken and thorough clinical examination was done to rule out any disease in general and pulmonary disorder in particular .Clinical examination, anthropometric measurements and PFT of female subjects were done by female P.G students of department .Findings are recorded in proforma.

All the subjects were informed about nature of study & method of recording various parameters were explained and demonstrated to them. After selecting the subjects, their anthropometric & pulmonary parameters were recorded in group of 10 children in morning hours 10-12 noon. Height was measured by making subject stand against a wall on which measuring scale was inscribed. Standing height was measured as the child stood erect with bare feet on flat floor with heels together & arms hanging naturally at the side. Heels, buttocks & occiput were touching the wall firmly. height was measured to nearest completed centimeters. Arm span was measured as the distance between the tips of both middle fingers of horizontally abducted and maximally out stretched hands with subject standing & facing the wall. Measurement was taken to nearest completed centimeter.Weight was recorded on weighing scale with bare footed and light clothings.

Body surface area was calculated from Mostellar formula[6]. children were made familiar with MIR-SPIROLAB and repeated demonstrations were given to them. PFT was performed on children with nose clipped. 3 reading were recorded for each parameter and best of 3 values were used for calculation. Subjects were encouraged to exert maximal efforts during recording of PFT parameters. Day to day calibration & calibration of the PFT machine in between was done. Data for all anthropometric and PFT parameters were recorded and expressed as mean, standard deviation. By using SPSS 16 (biostatistic software) data was analysed for Multiple logistic regression. In this study age, height, weight, arm-span & BSA are independent variable and FVC, FEV^1 and PEFR are dependent variable. Multiple logistic regression equation used in present study is

$Y= \beta+a(age)+b(height)+c(weight)+d(arm\text{-}span)+e(BSA)$ where Y =dependent variable and β=intercept.

RESULT/ OBSERVATION

Present study was done on group rural and urban school children (220 children in each group). Table 1 shows comparison of children in both groups with respect to anthropometric and PFT parameters. Children were not differing with respect to anthropometric parameters but significant difference was obsereved in PFT parameters FVC, FEV^1 & PEFR among rural and urban children.

Table 1: Anthropometric & PFT parameters in urban & rural children.

Variables	Urban children(n=220)		Rural children(n=220)	
	Boys	Girls	Boys	Girls
Age (years)	10±3.17	10±3.17	10±3.17	10±3.16
Height(cms)	137.50±19.40	134.89±17.05	137.52±19.40	134.90±17.05
Weight (kg)	25.08±8.54	26.10±8.78	25.79±8.10	26.65±7.90
Arm Span(cms)	139.08±19.127	136.46±16.53	30.85±13.35	29.56±11.95
BSA(m^2)	1.02±.302	1.04±.270	1.02±.30	1.0423±.270
FVC(Litres)	1.46±0.737**	1.39±0.63**	1.89±0.93**	1.64±0.66**
FEV^1 (Litres)	1.35±0.65***	1.24±0.54**	1.75±0.80***	1.58±0.62**
PEFR(Litres/sec)	3.16±1.70**	3.47±1.31**	3.96±1.76***	3.95±1.49**

** p<0.05, *** p<0.001

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Table 2 shows Corelation coefficient between PFT parameters and age, height weight, arm-span ,body surface area in rural school children. We observed highest correlation-ship between Age and FVC in boys, height and FVC in girls, also for height and FEV^1 in boys, FEV^1 and age in girls. PEFR has highest corelationship with arm span in both boys and girls in rural subjects.

Table 2 : Correlation between anthropometric and PFT variables in rural children.

Variables	Co relation co-effciant. Boys n=110	Girls n=110	Total n=220	significance p<0.001
FVC				
Age(years)	0.888	0.821	0.866	0.00
Height(cms)	0.765	0.842	0.775	0.00
weight(kg)	0.68	0.804	0.707	0.00
Arm span(cms)	0.736	0.821	0.754	0.002
BSA(m^2)	0.729	0.831	0.744	0.00
FEV^1				
Age(years)	0.799	0.902	0.801	0.00
Height(cms)	0.823	0.852	0.888	0.00
weight(kg)	0.714	0.799	0.735	0.00
Arm span(cms)	0.772	0.827	0.786	0.00
BSA(m^2)	0.758	0.833	0.773	0.00
PEFR				
Age(years)	0.746	0.784	0.778	0.00
Height(cms)	0.775	0.802	0.786	0.00
weight(kg)	0.69	0.756	0.717	0.00
Arm span(cms)	0.835	0.846	0.848	0.005
BSA(m^2)	0.731	0.785	0.753	0.00

FVC –Foreced Vital capacity, FEV^1–Forced Expiratory Volume in one second, PEFR- Peak Expiratory Flow Rate. BSA-Body Surface Area

Table 3 :Corelation between anthropometric and PFT variables in urban children.

Variables	Co- relation co-efficiant Boys n=110	Girls n=110	Total n=220	Significance p<0.001
FVC				
Age	0.805	0.834	0.812	0.00
Height	0.759	0.779	0.769	0.00
Weight	0.658	0.813	0.726	0.00
Arm span	0.757	0.771	0.764	0.00
BSA	0.688	0.818	0.741	0.00
FEV^1				
Age	0.644	0.783	0.758	0.000
Height	0.737	0.765	0.75	0.000
Weight	0.799	0.816	0.804	0.00
Arm span	0.737	0.756	0.746	0.00
BSA	0.669	0.792	0.717	0.000
PEFR				
Age	0.824	0.74	0.775	0.00
Height	0.866	0.793	0.823	0.00
Weight	0.714	0.719	0.704	0.00
Arm span	0.825	0.727	0.771	0.00
BSA	0.758	0.74	0.74	0.00

FVC –Foreced Vital capacity, FEV^1–Forced Expiratory Volume in one second, PEFR- Peak Expiratory Flow Rate, BSA-Body Surface Area

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FVC has highest correlation with age in both boys and girls in urban shidren. Weight is strong predictor of FEV^1 in girl in urban children as compared to weight in boys. While height is strong predictor of PEFR in boys (high correlation coeff.) than it is in girls in same group. (Table 3)

Multiple regression analysis in Table 4 shows that in rural children anthropometric parameters age, height, weight, arm span, BSA has strong positive correlation with FVC, FEV^1 &PEFR.

Table 4: Multiple regression analysis of PFT parameters against anthropometric parameters in rural children.

Dependent variable Rural children	INTERCEPT	Co-efficiant					R2
		Height	Weight	Arm span	Age	BSA	
FVC	-0.546	0.001	0.023	0.005	0.208	1.542	0.754
FEV^1	-0.759	0.007	0.017	0.006	0.175	1.052	0.794
PEFR	-1.577	0.024	0.031	0.018	0.359	2.206	0.734

P<0.001

Table 5: Multiple regression analysis of PFT parameters against anthropometric parameters in urban children

Dependent variable Urban children	INTERCEPT	Co-efficiant					R2
		Height	Weight	Arm span	Age	BSA	
FVC	-0.388	0.023	0.04	0.016	0.159	-1.99	0.674
FEV^1	-0.255	0.018	0.04	0.011	0.147	-2.151	0.655
PEFR	-0.989	0.031	0.026	0.031	0.361	1.496	0.68

Also in Table 5 we observed positive relationship between FVC,FEV1,PEFR and age,height,,weight,arm span and somewhat negative corelationship with BSA.

Prediction equation for both groups are derived and tabulated in Table 6 showing different set of prediction equation for rural and uban children.

Table 6: Prediction equations derived from our study.

PREDICTION EQUATIONS IN OUR STUDY.
RURAL CHILDREN
FVC= -0.546+0.208(AGE)+0.001(HEIGHT)+0.04(WEIGHT)+0.016(ARM SPAN)+1.99(BSA)
FEV^1= -0.759+0.175(AGE)+0.007(HEIGHT)+0.017(WEIGHT)+0.006(ARM PAN)+1.052(BSA)
PEFR=-1.577+0.359(AGE)+0.024(HEIGHT)+0.031(WEIGHT)+0.018(ARM PAN)+2.206(BSA)
URBAN CHILDREN
FVC=-0.388+0.159(AGE)+0.023(HEIGHT)+0.04(WEIGHT)+0.016(ARM SPAN)-1.99(BSA)
FEV^1=-0.255+0.147(AGE)+0.018(HEIGHT)+0.04(WEIGHT)+0.011(ARM SPAN)-2.151(BSA)
PEFR=-0.989+0.361(AGE)+0.031(HEIGHT)-0.026(WEIGHT)+0.031(ARM SPAN)+1.496(BSA)

Table 7 show the results of other studies and present studies , comparable result output was observed from our study.

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Table 7: Comparison of present study with other studies.

AUTHOR	No of cases	FVC	FEV^1	PEFR
For boys				
Rosenthal et al	---	2.82	2.36	4.97
Mallik SK et al (Delhi)	441	2.1±0.7	1.9±0.6	
Harikumaran NR (South India)	109	1.77±0.21	1.59±0.19	
Chowgule et al	---	2.54	2.26	5.4
Sharma PP et al (North India)	222	2.13±0.5	2.05±0.41	4.21±0.76
Doctor Tahera et al (West India)	408	2.01±0.46	1.76±0.38	4.74±0.96
Rajkapoor et al (North India)	186	1.63	1.49	3.845
Present study	Rural boys n=110	1.891±0.93	1.752±0.805	3.962±1.762
	Urban boys n=110	1.466±0.737	1.353±0.657	3.162±1.708
For girls				
Rosenthal et al		2.17	1.91	4.27
Mallik sk et al (Delhi)	441	1.94±0.4	1.7±0.8	
Chowgule et al		1.94	1.77	4.33
Sharma PP et al (North India)	222	1.82±0.41	1.73±0.43	4.01±0.88
Doctor Tahera et al (West India)	247	1.91±0.47	1.688±0.403	4.47±1.15
Rajkapoor et al (North India)		1.47	1.37	3.633
Present study	Rural girls n=110	1.640±0.666	1.586±0.622	3.953±1.496
	Urban girl n=110	1.399±0.635	1.240±0.548	3.475±1.312

DISCUSSION

Our study was formulated to ascertain which anthropometric variable predicts PFT parameter in rural and urban school children as well as we tried to derive prediction equation for these PFT parameters using anthropometric parameters among these children.

Firstly we observed significant difference in PFT parameters between these two groups all though they don't differ in relation with anthropometric parameters. So this thing can be attributable to various other factors like place of residence, socio-economic status, level of physical activity. We observed significantly lesser values for FVC, FEV^1 for girls in both groups except the PEFR values , similar results were observed Shamssain et al, [7] in their study in Libyan children who also observed that FVC ($r=0.442$, $P<0.001$) and FEV^1 ($r=0.479$, $P<0.001$) were significantly less in girls than boys. Also Wang et al,[8] concluded that for the same height boys, have greater lung function values than girls.

Present study shows lesser values of PFT parameters as compared to other studies (TableVII) this can be explained by racial difference, ethnic difference as observed by Connett GJ et al [2]. It was lower in Indian children than Chinese children, which is attributed to short chest length, a racial characteristic, in Indians. Vijayan VK et al [9] observed lower values as in south indian children and Rajkappor et al [10] observed higher values comparable with north indian children. Our PFT values were lesser than values of Rosenthal M et al [11], Mallik SK et al [12] Chowgule et al [13], Sharma PP et al [14], Doctor Tahera et al [15] but higher than Harikumaran et al, Rajkappor [10].

Age, height, weight, arm span and BSA were the anthropometric parameters having positive correlation with PFT parameters. In our study it is age in boys($r = 0.888$, $p<0.001$) and height($r = 0.842$, $p<0.001$) in girls for FVC in rural children. Similarly in urban children for FVC it is age for both boys($r= 0.805$ $p<0.001$) and girls ($r =$

0.834 ,p,0.001). In rural girls age is predictor of FEV^1(r= 0.902, p<0.001) while it is height(r=0.823,p<0.001) in rural boys and conversely for FEV^1 in urban boys & girls it is weight(r = 0.799, r = 0.816, p<0.001). While PEFR shows best correlation with arm span (r=0.848) in both rural boys and girls. It is height (r=0.866, p<0.001) in urban boys and height in urban girls (r=0.793,p<0.001) for PEFR. Vijayan et al, [9] in a study on south Indian children, showed that correlations of FVC and FEV^1 were highest with height followed by weight and age, however present study shows that it is age, height and arm span for FVC,FEV^1 &PEFR in rural children and age, weight and height in urban children. So consistently it is age and height which shows strong correlation with FVC,FEV^1 in this study in both groups. Our results are in accordance with Chatterjee et al, [16] who reported that FVC, FEV^1 and PEFR values increased progressively with age from 9 to 16 years and showed significantly high correlation coefficient with weight and negative correlation of FEV^1% with surface area. In our study BSA(Body surface area) is also one of independent variable for predicting PFT parameters . It is consistently correlated with FVC,FEV^1 in girls(r=0.831,r=0.833) than in boys for rural children and FVC in girl(r=0.818) in urban group. Similarly in various studies [17,18] BSA is also found to be a significant predictor of PEFR and FEV^1%.

CONCLUSION

The need for prediction equation separating both rural and urban school children is evident as the need for regional population specific equations for PFT. Consideration of this factor is required while evaluating PFT readings. Also the equations derived therin will help in evaluation pulmonary status in school children from central India.

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