Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (O)**
Sch. J. App. Med. Sci., 2013; 1(4):252-255 **ISSN 2347-954X (P)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjams.2013.v01i04.007

Research Article

Study of Forced Vital Capacity in Healthy School Children of Amritsar District, Punjab

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Abstract: The present study was undertaken on healthy school children in Amritsar district, which could serve as a basis for comparative evaluation in children during health as well as disease. The study was conducted among 800 school children (400 boys and 400 girls) of Amritsar district of Punjab, 6-15 years of age. They were categorized in 3 groups group A (6-9 years), group B (10-12 years), group C (13-15 years). Height, weight, body surface area were measured. Spirometry was done using "Medspiror" and Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV_1) were measured. On comparative evaluation, the FVC values increase with increase in age and are more in male children then in female children e.g. the value of FVC is 1.07L in group A, 1.75L in group B and 2.18L in group C and on comparing male with female children it is 1.08L, 1.81 and 2.24L in group A, B and C in males and 1.05L, 1.69L and 2.12L respectively in 3 groups in female children. The mean values of FVC in children increase with increase in age. Respiratory parameters are more in male children as compared to female children of comparable age groups. The purpose of the present study was to derive predictive equations for lung function from healthy children of Amritsar. The values observed in the present study are in agreement with those of various studies undertaken by other North Indian workers.
Keywords: Age, Body surface area (BSA), Forced Vital Capacity (FVC), Forced Expiratory $Volume_1$ (FEV_1), Pulmonary function tests (PFTs)

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INTRODUCTION

Among the various investigating modalities available, pulmonary function tests (PFTs) are an invaluable tool for the assessment of lung function. PFTs for lungs can be comparable to the ECG for heart [1].

These tests are a sensitive and objective way of detecting and measuring the severity of lung dysfunction, monitoring the progress of disease and assessing treatment. Lung function tests allow distinction between obstructive and restrictive disorders and indicate whether obstruction is reversible or fixed. They can help predict prognosis in progressive disorders such as cystic fibrosis, myopathies or scoliosis [2].

Pulmonary functions in healthy normal children are closely related to growth and development [3]. They are influenced by anthropometric, environmental, genetic, ethnic, socio-economic and technological variations [4].

No detailed study on lung function has been carried out in school children, in this part of the country in whom regional, socio-economic, cultural, dietary and other innumerable factors are likely to influence the physiological norms. So to mitigate the lacuna, the present study was undertaken in healthy school children, 6-15 years of age of both sexes, in Amritsar district which could serve as a basis for comparative evaluation in children during health and disease.

MATERIAL AND METHODS:

To conduct this study, 800 healthy school children both males and females were selected in the age group of 6-15 years. They were categorized in 3 groups.

Group A: 6-9 years
Group B: 10-12 years
Group C: 13-15 years

Before doing the tests a complete clinical checkup of each child was done to rule out any significant problem like respiratory diseases, body deformities of the thorax, cardiac ailments etc. Children with major medical illnesses and even those having upper and lower respiratory tract infection on the day of testing were excluded from the study. The pulmonary function tests were carried out with computerized spirometer, "Medspiror" [1, 3, 4, 5]. Testing procedures were quite simple. From subject's point of view only one maneuver was required to accumulate all test data, a forced vital capacity (FVC). All gas volumes were corrected to BTPS (body temperature, ambient pressure and saturated with water vapours) automatically by the

instrument. Medspiror was used to calculate the following parameters viz FVC, FEV1 and FEV1/FVC.

All tests were carried out in the morning in post-absorptive phase. The subjects were familiarized by the instrument and the techniques to be used. The readings were taken in the standing position. Age in years, height in centimeters (without shoes), and body weight in kilograms were recorded. Body surface area was read from nomogram of DuBois and DuBois [6]. Each subject was given two test runs for each test and best of the three test readings was taken. The terminology and observation used for the different parameters was suggested by Cotes [7].

Statistical analysis was done for all the parameters, 'p' value was determined. P>0.05 was considered as non significant. Independent student t test was used for between groups comparison. Data obtained was fed to the computer and analyzed and valid conclusions were drawn.

RESULTS

Table 1 shows the mean±SD of four anthropometric parameters in total subjects of each group and males and females separately as well. Table 2 shows mean±SD of the respiratory parameters in total subjects of each group and male and female children of each group. It shows that the parameters rise gradually with age in different groups. The comparison between various respiratory parameters between two groups and 't' value with statistical significance is shown in table 3. Here the comparison between the two groups showed that when group A was compared with group B there was highly significant increase of FVC and FEV_1 while FEV_1/FVC% showed only significant increase. On comparison between group B and C FEV_1/FVC% showed no significant change while other FVC and FEV_1 showed highly significant increase. Table 4 shows 't' value with statistical significance of various parameters on comparison between males and females of the same group. It shows that although there was no statistically significant difference of any respiratory parameter in males and females of group A but in group B there was highly significant difference in FVC and FEV_1 except FEV_1/FVC%, where no significant difference was observed. On comparing males and females of group C, there was highly significant increase in both FVC and FEV_1 except in FEV_1/FVC% in which there was no significant increase.

Table 1: Showing Mean and Standard Deviation of 4 Anthropometric Parameters in Males and Females

Group	Sex	Age in years	Height in cms	Weight in kgs	Body surface area (in m^2)
A (6-9 yrs)	Male	7.86±1.00	121.49±7.01	22.05±3.46	0.87±0.09
	Female	8.72±0.45	123.71±7.04	21.59±3.49	0.87±0.09
B (10-12 yrs)	Male	10.92±0.83	137.55±8.32	30.40±6.22	1.09±0.13
	Female	11.47±0.68	139.83±7.04	30.91±6.61	1.11±0.13
C (13-15 yrs)	Male	13.72±0.73	149.86±9.20	37.30±7.17	1.26±0.15
	Female	13.37±0.49	149.05±5.21	37.99±5.99	1.27±0.11

Table 2(a): Showing Mean and Standard Deviation of Respiratory Parameters in Different Groups

Parameters	Group A	Group B	Group B
FVC (L)	1.07±0.25	1.75±0.39	2.18±0.28
FEV_1 (L)	1.05±0.23	1.69±0.38	2.12±0.30
FEV_1/FVC%	98.33±4.68	96.92±6.67	97.23±3.02

Table 2(b): Showing Mean and Standard Deviation of Respiratory Parameters in Males And Females Of Different Age Groups

Parameters	Sex	Group A	Group B	Group C
FVC (L)	Male	1.08±0.23	1.81±0.40	2.24±0.36
	Female	1.05±0.27	1.69±0.38	2.12±0.25
FEV_1 (L)	Male	1.06±0.21	1.75±0.38	2.17±0.35
	Female	1.03±0.25	1.62±0.31	2.07±0.24
FEV_1/FVC%	Male	98.12±5.40	97.48±6.69	97.01±2.73
	Female	98.65±3.32	96.36±6.64	97.44±3.88

Table 3: Showing 't' Value With Statistical Significance of Various Lung Function Parameters on Comparison Between Two Groups

	FVC (L)	FEV_1 (L)	FEV_1/FVC%
Group A & B			
't' value	24.25	23.72	2.88
'p' value	<0.001	<0.001	<0.05
Significance	H.S	H.S	S
Group B & C			
't' value	13.71	13.75	0.62
'p' value	<0.001	<0.001	<0.05
Significance	H.S	H.S	N.S

N.S:Not significant (p>0.05), S: Significant (p<0.05), H.S: Highly significant (p<0.01) and (p<0.001)

Table 4: Showing 't' Value With Statistical Significance of Various Lung Function Parameters on Comparison Between Males and Females of The Same Group

	FVC (L)	FEV_1 (L)	FEV_1/FVC%
Group A (Male & Female)			
't' value	0.94	1.03	0.88
'p' value	>0.05	>0.05	>0.05
Significance	N.S	N.S	N.S
Group B (Male & Female)			
't' value	2.86	3.22	1.56
'p' value	<0.001	<0.001	>0.05
Significance	H.S	H.S	N.S
Group C (Male & Female)			
't' value	2.74	2.36	0.90
'p' value	<0.01	<0.05	>0.05
Significance	H.S	S	N.S

N.S:Not significant (p>0.05), S:Significant (p<0.05), H.S:Highly significant (p<0.01) and (p<0.001)

DISCUSSION

The evaluation of pulmonary function tests in children is at present largely confined to clinical and radiographic study. With an increasing demand for evaluation of pulmonary insufficiency in asthmatic children it has become necessary to establish normal standards of pulmonary function in them. The role of these tests in early detection of pulmonary dysfunction has been amply emphasized by Comroe et al [8].

The purpose of the present study was to derive predictive equations for lung function from healthy children of Amritsar. Reference value describes the level of an index for a group of healthy persons that is the reference population in terms of defining variable, known as reference variable. Commonly used reference variable include ethnic group, age, gender and one or more induces of body size. Thus, the reference values are generated from an equation and the result of an individual subject is obtained by inserting values of his/her features into equation. Number of variables in the reference equation depends on the index e.g. it is more for primary indices such as FEV1 and FVC to which both body size and age contribute then to their ratio FEV1%. 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. In India, several studies were carried out on school children to predict the lung function using anthropometric variables. The studies were conducted at Chandigarh [9], Bombay [5], Delhi [10] and Hyderabad [11] have projected different types of regression equations for lung functions in Indian children. The present study done has used age, height, weight, body surface area and gender as independent variables for the prediction equation of respiratory parameters.

Vijayan et al [12] in a study on south Indian children showed that correlations of FVC and FEV1 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 [13] concluded that for the same

height, boys have greater lung function values than girls.

Connett et al [14] suggested that there were important differences in lung function between races. It was lower in Indian children than Chinese children, which is attributed to short chest length, a social characteristic, in Indians. Vijayan et al [12] reported that pulmonary function measurements in south Indian children were similar to those of Western India and lower than Caucasians, while Raj Kapoor et al [15] derived values of lung function were comparable to other north Indian children but higher than south Indian children. Chatterjee et al [16] observed that boys of his study were much closer to boys of Delhi in FVC but higher than south Indian boys in FEV1.

CONCLUSION:

The following conclusions are drawn from the present study.

That the mean values of various lung function tests increase with increase in age. Male children have higher values of all lung function tests as compared to female children of comparable age groups. The values observed in the present study are generally in agreement with the observations of various studies undertaken by north Indian workers. In general the values were lower as compared to the western standards. This was due to difference in stature and higher nutritional status of the western subjects.

The FVC and FEV_1 values obtained from the present study on healthy school children in Amritsar district, will serve as a basis for comparative evaluation in children during health as well as disease. The purpose of the present study was to derive predictive equations for lung function from healthy children of Amritsar, Punjab.

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