

A Comparative Study of Pulmonary Function Test in School Children of Industrial Area and Non Industrial Area

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Abstract

Background: Pulmonary function test is an important tool in the diagnosis, assessment and management of respiratory diseases in adults and older children. The main objective was to study the pulmonary function test in school children of industrial and Non industrial area.

Method: The study was carried out in a school of industrial area i.e., Advani Arlicon Higher secondary School, Urla Road, Birgaon and a school of Non Industrial area i.e., Vivekananda Higher Secondary School, Mana Camp of Raipur city from April to August 2012.. The subjects were evaluated through pulmonary function test by using Spirometry method. A total of 400 subjects aged between 11-18 years were included. For the study Permission from Institutional Ethics Committee was obtained. Initially informed individual consent was taken from all the patients included in the study.

Results: When Mean FEV1 (in liters) for Males in Cases was compared with Controls, p value was found to be <0.0001. When Mean FEV1 (in liters) for Females in Cases was compared with Controls, p value was found <0.0001. When PEFr (in liters/Sec) for Males in Cases was compared with Controls, p value was found to be 0.0290. When PEFr (in liters/Sec) for Females in Cases was compared with Controls, p value was found to be 0.3117.

Conclusion: To conclude, the problems are diverse, but it is important to keep close control over pollutants. Some preventable strategies need to be taken for acceptable environment for the future generations.

Keywords: Pulmonary function test, School children's, Industrial area, Non industrial area.

Introduction

Pulmonary function test is an important tool in the diagnosis, assessment and management of respiratory diseases in adults and children.¹

Pulmonary function tests are valuable investigations in the management of patients with suspected or previously diagnosed respiratory diseases.

They provide important information relating to the large and small airways, the pulmonary parenchyma

and the size and integrity of the pulmonary capillary bed. Although they do not provide a diagnosis per se, different patterns of abnormalities are seen in various respiratory diseases which help to establish diagnosis.²

Several factors can be responsible for disruption of normal lung development and growth, leading to reduced lung function. These include intrauterine growth retardation, viral infections, premature birth, inflammatory conditions, genetic changes and environmental toxicants.³

Children have increased exposure to many air pollutants as compared with adults because of higher minute ventilation and higher levels of physical activity and also because children spend more time outdoors than adults.

Respiratory health status in urban & rural 220 school children of 6 to 15 years of age group found, significantly

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decreased Peak Expiratory Flow rate (PEFR) In urban children as compared to rural children. Air pollution was concluded as the sole cause for decrement of PFT parameters in urban children. ⁴

Many studies have shown that air pollution is strongly associated with human health, and the results of air pollution include an increased mortality rate, an increased number of patients with respiratory or cardiovascular diseases at outpatient departments or emergency rooms, the aggravation of asthma, the increase of respiratory symptoms or the disease of pulmonary function. ⁵

Method

The study was carried out in a school of industrial area i.e., Advani Arlicon Higher secondary School, Urla Road, Birgaon and a school of Non Industrial area i.e., Vivekananda Higher Secondary School, Mana Camp of Raipur city from April to August 2012. The subjects included in the study were school children aged between 11-18 years, residing in their respective residence for a period of 10 years. Objective and method of the study was fully explained and consent was taken from subject prior to start of the study. The subjects were evaluated through pulmonary function test by using Spirometry method. A total of 400 subjects aged between 11-18 years (200 school children of industrial area and 200 school children of Non industrial area) were included for the study. In all the subjects' height is measured in centimeters and weight in kilograms using standardized techniques. Pulmonary function test was recorded with the spirometer–HELIOS-501, a turbine based device manufactured by recorders and Medicare systems (RMS) Pvt Ltd, Chandigarh, India. In all subjects, Pulmonary Function Test was performed using Bidirectional FVC test and results obtained were compared with predicted reference values.

Results

Table 1: Age wise Distribution of Cases & Controls

Age in years	Cases		Controls		Total
	No of Cases	Percent	No of Cases	Percent	
11 to 12	2	1%	6	3%	8
13 to 14	54	27%	78	39%	132
15 to 16	75	37.5%	83	41.5%	158
17 to 18	69	34.5%	33	16.5%	102
Total	200	100%	200	100%	400

In the study group of Cases (Industrial Area school children), amongst total 200 subjects, there were 2 subjects aged between 11-12 Years, 54 subjects aged between 13-14 Years, 75 subjects aged between 15-16 Years & 69 subjects were found to be between 17-18 Years.

In the study group of Controls (Non-Industrial Area school children), amongst total 200 subjects, there were 6 subjects aged between 11-12 years, 78 subjects aged between 13-14 Years, 83 subjects aged between 15-16 Years & 33 subjects were found to be between 17-18 Years.

Table 2: Sex wise Distribution of Cases & Controls

Sex	Cases		Controls		Total
	No of Cases	Percent	No of Cases	Percent	
Males	72	36%	88	44%	160
Females	128	64%	112	56%	240
Total	200	100%	200	100%	400

In the study group of Cases (Industrial Area school children), amongst total 200 subjects, there were 72 Male subjects & 128 Female subjects. Females are more compared to Male.

In the study group of Controls (Non-Industrial Area school children), amongst total 200 subjects, there were 88 Male subjects & 112 Female subjects. (More as compared to Males).

Table 3: Correlation of Mean FVC (Forced Vital Capacity) in Liters with Age in Cases & Controls

Age in years	Cases	Controls	P value
	Mean ±SD	Mean ±SD	
11 to 12	2.085±0.007 (N=2)	2.381±0.181 (N=6)	0.0705
13 to 14	2.210±0.381 (N=54)	2.505±0.389 (N=78)	<0.0001
15 to 16	2.251±0.344 (N=75)	2.777±0.454 (N=83)	<0.0001
17 to 18	2.336±0.406 (N=69)	2.849±0.501 (N=33)	<0.0001

In the study group of Cases (Industrial Area school children), Mean FVC (in Liters) for subjects aged between 11-12 Years was found to be 2.085±0.007, for subjects aged between 13-14 Years was found to be 2.210±0.381, For subjects aged between 15-16 Years was found to be 2.251±0.344, For subjects aged

between 17-18 Years was found to be 2.336 ± 0.406 respectively.

In the study group of Controls (Non-Industrial Area school children), Mean FVC (in Liters) for subjects aged between 11-12 Years was found to be 2.381 ± 0.181 , for subjects aged between 13-14 Years was found to be 2.505 ± 0.389 , For subjects aged between 15-16 Years was found to be 2.777 ± 0.454 , For subjects aged between 17-18 Years was found to be 2.849 ± 0.501 respectively.

When Mean FVC (in Liters) for subjects aged between 11-12 Years was compared with Controls, p value was found to be 0.0705 (statistically not significant), $t = 2.195$ with 6 degree of freedom.

When Mean FVC (in Liters) for subjects aged between 13-14 Years was compared with Controls, p value was found to be <0.0001 (statistically highly significant), $t = 4.312$ with 130 degree of freedom.

When Mean FVC (in Liters) for subjects aged between 15-16 Years was compared with Controls, p value was found to be <0.0001 (statistically highly significant), $t = 8.131$ with 156 degree of freedom.

When Mean FVC (in Liters) for subjects aged between 17-18 Years was compared with Controls, p value was found to be <0.0001 (statistically highly significant), $t = 5.518$ with 100 degree of freedom.

Table 4: Correlation of Mean FEV1 (Forced Expiratory Volume in one second) in Liters in Cases & Controls

	Cases	Controls	P value
Males	2.508 ± 0.3818 (N=72)	2.850 ± 0.4560 (N=88)	<0.0001
Females	2.103 ± 0.2622 (N=128)	2.390 ± 0.2247 (N=112)	<0.0001

In the study group of Cases (Industrial Area school children), amongst total 200 subjects, Mean FEV1 (in Litres) for Males was Found to be 2.508 ± 0.3818 (More as compared to Females), Mean FEV1 (in Litres) for Females was Found to be 2.103 ± 0.2622 (Less as compared to Males).

In the study group of Controls (Non-Industrial Area school children), amongst total 200 subjects, Mean FEV1 (in Litres) for Males was Found to be 2.850 ± 0.4560 (More as compared to Females), Mean FEV1 (in Litres)

for Females was Found to be 2.390 ± 0.2247 (Less as compared to Males).

When Mean FEV1 (in liters) for Males in Cases was compared with Controls, p value was found to be <0.0001 (statistically highly significant), $t = 5.074$ with 158 degree of freedom.

When Mean FEV1 (in liters) for Females in Cases was compared with Controls, p value was found to be <0.0001 (statistically highly significant), $t = 9.053$ with 238 degree of freedom.

Table 5: Correlation of Mean PEFR (Peak Expiratory Flow Rate) in L/sec Cases & Controls

	Cases	Controls	P value
Males	7.435 ± 1.252 (N=72)	7.983 ± 1.780 (N=88)	0.0290
Females	6.349 ± 1.372 (N=128)	6.526 ± 1.326 (N=112)	0.3117

In the study group of Cases (Industrial Area school children), amongst total 200 subjects, Mean PEFR (in Liters/Sec) for Males was Found to be 7.435 ± 1.252 (More as compared to Females), Mean PEFR (in Litres/Sec) for Females was Found to be 6.349 ± 1.372 (Less as compared to Males).

In the study group of Controls (Non Industrial Area school children), amongst total 200 subjects, Mean PEFR (in Liters/Sec) for Males was Found to be 7.983 ± 1.780 (More as compared to Females), Mean PEFR (in Litres/Sec) for Females was Found to be 6.526 ± 1.326 (Less as compared to Males).

When PEFR (in liters/Sec) for Males in Cases was compared with Controls, p value was found to be 0.0290 (statistically not significant), $t = 2.204$ with 158 degree of freedom.

When PEFR (in liters/Sec) for Females in Cases was compared with Controls, p value was found to be 0.3117 (statistically not significant), $t = 1.014$ with 238 degree of freedom.

Discussion

According to Naif A Sliman et al lung function is assessed using a broad array of tests that measure lung volume, airflow and gas diffusion. The most convenient test procedure is spirometry that measures how well the lung functions in exhaling air. In assessment of pulmonary function, measurements of forced vital

capacity (FVC), one second forced expiratory volume (FEV1) and forced mid-expiratory flow rate are most commonly used.

Such measurements, to be of any clinical value, must be compared with expected normal values for the subject. These values may be influenced by several factors, especially sex, height, age, usual habitat and ethnic and racial origin.⁶

Eleni A Papadimitriou et al number of cohort studies performed to date has demonstrated that residing in an industrial area may result in elevated prevalence of asthma diagnosis and asthma related symptoms in children. Moreover, other cohort studies demonstrate that children residing in an industrial area have reduced lung function as indicated by spirometric values.

The effect of industrial vs. rural environment in the respiratory status of (62 children aged 11-12 years) in Oinofyta (industrial area) and 42 in Makarkomi (rural area), found prevalence of reduced pulmonary indices in children by type of residency.⁷

K L Timonen et al studied effects of air pollution on changes in lung function, conducted in 141 children, found the reductions in Forced Vital Capacity (FVC). The reduction in forced vital capacity was 0.5% for each 10 µg/m³ increase in Black smoke.⁸

E. Von Mutius et al studied environmental exposure to high levels of air pollution, such as ambient sulphur dioxide, nitrogen dioxide and particulate matters has long been related to the incidence of lower respiratory tract illness in children.⁹

Wieslaw Jedrychowski et al studied annual average concentration of SO₂ & suspended particulate matter (SPM) exceeding 180-250 µg/m³ are consistently associated with higher rates of acute and chronic respiratory diseases and are inversely related to lung function.¹⁰

Conclusion

Mean age of cases was higher as compared to controls.

There were more females as compared to Males in cases as well as in controls in our study.

Mean FVC (in Litres) was higher in controls as compared to Cases, in males (highly significant, p =

< 0.0001) as well in females (highly significant, p = < 0.0001) subjects.

Mean FVC (in Litres) in correlation with Age, in 11-12 years age group. It was found to be (not significant, p = < 0.0705), but in age groups between 13-14, 15-16 & 17-18 years, it was found to be (highly significant, p = < 0.0001).

To conclude, the problems are diverse, but it is important to keep close control over pollutants. Some strategies need to be taken for acceptable environment for the future generations.

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