Research Article

Spirometric studies in normal healthy Punjabi male subjects of rural and urban areas between 20 and 50 years of age group

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Abstract

Background: Inhalation of polluted air over a long period of time leads to proliferation and fibrotic changes in lungs. Early recognition of this damage provides an important clue to insure good health. Spirometery is an invaluable screening test to identify patients with air flow obstruction.

Objective: To study spirometric parameters in normal healthy Punjabi males of rural and urban areas between 20 and 50 years of age group

Materials and Methods: This study was conducted among 200 urban and 200 rural Punjabi males between 20 and 50 years of age in and around Patiala, Punjab. Pulmonary function tests were carried out in standing position, height was measured in centimeters, weight was measured in kilograms, and body surface area was read from "Nomogram" Dobous and Dobous.

Result: The ventilatory tests such as peak expiratory flow rate (PEFR), forced expiratory flow ($FEF_{0.2\%–1.2\%}$ and $FEF_{25\%}$ measured by computerized spirometer (Med-spiror) showed a highly significant decline in urban subjects. While in rest of the parameters, there is statistically nonsignificant decrease in urban subjects. The cause of decline in flow volume in urban subjects is owing to industrial pollution (SO_2, SO_4^{2-}, NO_2), suspended particulate matter and cumulative dust exposure, and exhaust emission of vehicles. The cause of better preserved lung function, especially the flow volumes in rural subjects is owing to excessive physical activity and because of nonexposure to pollution.

Conclusion: The strategies such as use of air purifiers, use of mask, better fuel for vehicles, proper and timely servicing of vehicles, regular health checkups, and awareness of effects of pollution on health need to be adopted for protection from air pollution.

KEY WORDS: PEFR, $FEF_{0.2–1.2}$, $FEF_{25\%}$, air pollution, rural population

Introduction

Pulmonary function tests (PFTs) have developed from tools for carrying out physiological studies to clinical tools for the identification, management, and follow-up of respiratory illnesses, because they can be used to give objective information about the status of an individual respiratory system. PFTs are affected by the factors including diet, obesity, air pollution, and physical activity level. In the last two decades, rapid economic growth and development worldwide has resulted in an improvement of people's nutritional status.[1]

PFTs determine lungs capacity of holding air, quantity of air going in and out, and how well lungs take in oxygen and give out carbon dioxide from blood. Spirometery being the most commonly peformed lung function test is considered as the first choice in diagnosis of lung pathology. Spirometery is a technique used to measure amount and flow of air inhaled and exhaled and the lung functions. It measures amount of air that can be moved in and out of one's lungs.[2]

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Various spirometric studies have been done in which it was observed that air pollution is one of the serious health problems faced by the people in the developing countries and significantly associated with lower lung function in the urban adolescents, and it was of the restrictive lung function type. After adjusting for other variables, prevalence of chronic bronchitis was significantly associated with heating source, age, area of residence, and lower socioeconomic status. Air quality assessment in and around urban slums of Delhi city indoor air pollutants (e.g. respirable suspended particulate matter, Co_2, Co, So_2, No_2) for all the three seasons showed that women and children are more vulnerable to respiratory problems when compared with other sexes. Computerized spirometry on nonsmoking students showed that regression norms may be used to predict the spirometric values in young Indian population of similar age group as the study population. Spirometery on urban and rural children showed that peak expiratory flow rate (PEFR) values correlate best with height; there was no difference in sex, religion, and urban/rural children. It was also observed that farmers' children have become adapted towards the allergens to which they are exposed. Children inhaling grossly polluted air suffer from adverse lung reaction and genetic abnormality in the exposed tissues.[3–9]

Materials and Methods

This study was conducted among 200 urban and 200 rural Punjabi male subjects between 20 and 50 years of age in and around Patiala, Punjab. Subjects were judged to be healthy on the criteria of no exertional dyspnea/general debility, no h/o current/past cardiorespiratory disorder or frequent cold, obvious sign of malnutrition, no obesity, and no h/o of smoking, a detailed physical examination was carried out, and Hb estimation was done. The lung function tests were suggested by Gandevia and Hugh-Jones and Cotes. Test procedures were quite simple from patient's point of view; only two maneuver were required to accumulate all test data, (i.e., a forced vital capacity and maximum voluntary ventilation). All gas volumes are corrected to BTPS (body temperature, ambient pressure, and saturated with water vapour) automatically by the instrument. PFTs were carried out in standing position, height was measured in centimeters, weight was measured in kilograms, and body surface area was read from "Nomogram" Dobous and Dobous.

In the procedure of lung function test, a nose clip was attached to the subject and a clean mouthpiece inserted into the breathing tube, and two maneuvers were performed.

1. Forced vital capacity test: Subjects were instructed to take maximum inspiration and then place mouthpiece firmly in mouth and performed maximum expiration.
2. Maximum voluntary ventilation test procedure: After a rest of 5 min, the subject was asked to breathe as rapidly and deep as possible in and out from the mouthpiece. Maximal voluntary ventilation (MVV) test was run for 12 s. Results were taken on the built-in printer containing all the patient information and calculated values of all the 14 parameters.

Statistical Analysis

The various statistical considerations used were mean, standard deviation, and correlation coefficient, and regression equation was evaluated by constructing ANOVA table.

Result

The anthropometric parameters in urban and rural population are shown in Table 1, showing mean standard deviation, "*t*" value, "*p*" value, and significance. The values of PEFR,

Table 1: Comparison of anthropometric parameters in urban and rural population

Parameters	Urban (mean ± SD)	Rural (mean ± SD)	*T*	*P*	Sig.
Age (years)	33.18 ± 9.37	31.54 ± 9.45	1.75	>0.05	NS
Weight (kg)	60.33 ± 11.81	61.22 ± 10.38	0.84	>0.05	NS
Height (cm)	167.90 ± 6.21	167.28 ± 6.79	0.91	>0.05	NS
FVC	3.12 ± 0.57	3.20 ± 0.57	0.32	>0.05	NS
$EFV_{0.5}$	1.91 ± 0.58	1.98 ± 0.57	1.28	>0.05	NS
FEV_1	2.66 ± 0.53	2.73 ±0.61	1.40	>0.05	NS
FEV_3	3.11 ± 0.68	3.18 ± 0.60	1.34	>0.05	NS
PEFR	6.97 ± 2.70	7.52 ± 2.76	2.22	<0.05	S
$FEF_{25–75}$	3.19 ± 1.17	3.18 ± 1.14	0.11	>0.05	NS
$FEF_{0.2–1.2}$	5.33 ± 1.90	5.77 ± 1.88	2.31	<0.05	S
$FEF_{25\%}$	5.65 ± 1.95	6.29 ± 1.96	3.26	<0.05	S
$FEF_{50\%}$	3.74 ± 1.37	3.83 ± 1.40	0.61	>0.05	NS
$FEF_{75\%}$	1.66 ± 0.89	1.77 ± 0.96	1.23	>0.05	NS
$FEV_{0.5}$/FVC	0.61 ± 051	0.61 ± 0.74	0.21	>0.05	NS
FEV_1FVC	0.85 ± 009	0.852 ± 0.10	0.39	>0.05	NS
FEV_3/FVC	99.40 ± 2.41	99.28 ± 2.83	0.83	>0.05	NS
MVV	108.34 ± 37.87	113.54 ± 31.43	0.80	>0.05	NS

S, Significant; NS, Nonsignificant.

$FEF_{0.2–1.2}$, $FEF_{25\%}$ show statistically significant difference between urban and rural population.

PEFR in Table 1 shows mean SD and *t* value significance in the urban and rural population and show that it is statistically significant.

$FEF_{0.2-1.2}$ in Table 1 show mean SD and *t* value significance in the urban and rural population and show that it is statistically significant.

$FEF_{25\%}$ in Table 1 show mean SD and t value significance in the urban and rural population and show that it is statistically significant.

Table 2 shows correlation coefficient r'\ and *p* values of FEF_{25} of urban and rural population.

Discussion

This study was done with an aim to collect more data on urban and rural population as there was marked difference between urban and rural areas and to bridge the gaps in our knowledge.

The study was conducted to draw evidence as to what influence the city pollution and industrial dust inhalation has on pulmonary function. The study under investigation represented a cross-sectional study of lung function status of urban and rural healthy population.

The observed lung function test in this study showed that while comparing, urban and rural population the PEFR shows statistically highly significant decrease in urban population. PEFR has statistically nonsignificant correlation with the weight, height, and body surface area.[3,5,7,9]

Table 2: Correlation coefficient "*r*" and "*p*" value of $FEF_{25\%}$

Para meters	Urban		Rural	
	r	*p*	*r*	*p*
Age	1.53	>0.05	–0.95	>0.05
Weight	–0.13	>0.05	0.87	>0.05
Height	–2.06	>0.05	0.85	>0.05
BSA	–0.80	>0.05	1.01	>0.05
FVC	–1.92	>0.05	2.12	<0.05
$EFV_{0.5}$	1.80	>0.05	3.05	<0.05
FEV_1	1.63	>0.05	2.65	<0.05
FEV_3	0.24	>0.05	1.92	>0.05
PEFR	10.05	<0.001	13.31	<0.001
$FEF_{25\%–75\%}$	1.79	>0.05	2.18	<0.05
$FEF_{2–12}$	42.36	<0.001	28.99	<0.001
$FEF_{25\%}$	1	–	1	–
$FEF_{50\%}$	14.95	<0.001	4.20	<0.01
$FEF_{75\%}$	0.68	>0.05	0.81	>0.05
$FEV_{0.5}$/FVC	2.19	>0.05	1.84	>0.05
FEV_1/FVC	3.13	<0.01	1.37	>0.05
FEV_1/FVC	2.31	<0.05	–1.03	>0.05
MVV	0.94	>0.05	2.38	<0.05

The lower value of PEFR in urban population is owing to industrial dust inhalation, vehicle exhaust emission, and suspended particulate matter and depends upon duration of exposure to pollution.[1,3]

In this study, the $FEF_{0.2–1.2}$ shows statistically nonsignificant negative correlation with age, weight, height, and body surface area. In rural male subjects, $FEF_{0.2–1.2}$ show statistically highly significant positive correlation with body surface area and statistically nonsignificant negative correlation with age.[9] The decrease in $FEF_{0.2–1.2}$ in urban subjects is owing to suspended particles in the environment, exhaust emission of vehicles, and exposure to industrial dust.[3] The study also analyzed that $FEF_{25\%}$ decreased significantly in urban population when compared with the rural. It was observed that there was significant correlation with the weight and statistically nonsignificant negative correlation with height and body surface area and statistically negative nonsignificant correlation with age; studies have also reported that dust inhalation of industries and exhaust emission of vehicles and prolonged exposure to pollution can lead to deterioration of $FEF_{25\%}$.[3–9]

The parameters such as FVC, $FEV_{0.5}$, FEV_3, $FEV_{25\%–75\%}$ and MVV showed statistically nonsignificant difference while comparing urban vs. rural areas. The reason for this is probably owing to usage of modern harvesting techniques which cause more air pollution. It has been observed in rural areas. Most of the subjects are agriculturists and thus exposed to various allergens and dusts and cause reduction in FEV_3 in rural people.[4,8] It is contended that grain dust contains airborne endotoxins which may cause inflammatory reaction in bronchopulmonary system. Persons exposed to areas of maximum dust concentration are more vulnerable to impairment of expiratory flow.[3,5]

Conclusion

The study of lung function parameters conducted on 200 urban and 200 rural healthy male subjects showed that the cause of highly significant decline in three parameters (PEFR, $FEF_{0.2–1.2}$, $FEF_{25\%}$) of urban subjects was owing to industrial pollution, suspended particulate matter (Co_2, Co, So_2, No_2), and exhaust emission of vehicles in the urban areas. Air pollution in the residence area may be the causal chain of restriction leading to retardation in the pulmonary function growth during the preadolescent years, and the cause of better preserved lung functions, especially the flow volumes of the rural subjects probably is owing to excessive physical activity and lesser exposure to air pollution. The strategies such as use of air purifiers, use of mask, better fuel for vehicles, proper and timely servicing of vehicles, regular health checkups, and awareness of effects of pollution on health need to be adopted for protection from air pollution.

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