

LONGITUDINAL STUDY OF LUNG FUNCTION DEVELOPMENT IN A COHORT OF INDIAN MEDICAL STUDENTS: INTERACTION OF RESPIRATORY ALLERGY AND SMOKING

S. WALTER* AND J. RICHARD**

**Department of Physiology and*

***Department of Biostatistics,
Christian Medical College,
Vellore - 632 002*

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Abstract : This study was done to identify some factors that affect the growth and development of lung function during adolescence and early adulthood. Forced expiratory spiograms and peak expiratory flow rates were obtained in a cohort of normal young men (n = 63) over a period of 4 years, at intervals of approximately 2 years. Two factors that disturbed the normal pattern of lung function development in this group were smoking and respiratory allergy. Among the smokers and the allergics the decline in the forced expiratory volume expressed as a percentage of the forced vital capacity (FEV₁%), the forced expiratory flow in the middle half of the forced vital capacity (FEF₂₅₋₇₅%) and the FEF₂₅₋₇₅ % expressed as a ratio of the forced vital capacity (FEF/FVC) was more than double that among the normal subjects. The number of smokers and of allergics increased during the course of the study from 15 to 19 and from 16 to 23 respectively. There was a significant (P < .01) interaction between smoking and the manifestation of respiratory allergy. Among nonsmokers, the number of allergic subjects increased from 12 to 13, while among smokers it increased from 4 to 10, during the four years.

Key words : lung function pulmonary function respiratory allergy
nasobronchial allergy smoking

INTRODUCTION

Several factors, genetic and environmental are known to influence the growth and development of lung function. These have been explored by numerous cross sectional studies. However there are very few longitudinal studies (1) which have attempted to evaluate these factors. Longitudinal studies are essential to define true growth effects (2) and the factors that influence these effects. This is particularly important during the late teens, when exposure to inhalant pollutants, either as a smoking habit or as an occupational exposure is first beginning to occur. This study was therefore done to identify some factors that affect the growth and development of lung function in normal young individuals during late adolescence and early adulthood. This was part of a cohort study, undertaken

in a population of medical students who were studied longitudinally over a period of four years.

METHODS

The men students of two consecutive batches of the Christian Medical College in Vellore, India, were the subjects of the study. They were residents of the college campus throughout their medical studies and formed a relatively homogenous population of the required age group. 63 students from whom an informed consent was obtained, took part in the study. Three serial tests were done on each subject at intervals of approximately two years. At each test, information regarding smoking habits, episodes of respiratory infections and allergic manifestations was obtained from them. Information

*Corresponding Author

was also obtained regarding a family history of respiratory allergy. This was considered positive, when a sibling, parent, parents' sibling or grand parent had a respiratory allergy. The criteria defined by Broder et al (3) were applied for the diagnosis of allergic rhinitis.

Forced expiratory spiograms (FES) were obtained using the Collins' respirometer with the subjects seated. Peak expiratory flows (PEF) were obtained with the Wright Peak flow meter. Instruments were calibrated before the tests. The forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), FEV_1 expressed as a percentage of FVC ($FEV_1\%$) forced expiratory flow at 25 to 75% of FVC (FEF 25-75%) and FEF 25-75% expressed as a ratio of FVC (FEF/FVC) were obtained from the FES. At the time of the study, none of the subjects had suffered a recent upper respiratory infection or allergic episode and none was on antihistaminics or bronchodilators. All tests were done at the same time of the day to avoid possible diurnal variations.

Data obtained were computerised. Group comparisons were made using the student t test. Paired tests were used for assessing longitudinal changes. Analysis of variance and multiple classification analysis were used to identify variables that influenced these longitudinal changes (4).

RESULTS

Multiple classification analysis showed that two important factors that influenced pulmonary function growth, were smoking and respiratory allergy. Subjects were therefore grouped accordingly. Of the 63 subjects, there were 36 nonallergic nonsmokers, 12 allergic nonsmokers, 11 non allergic smokers, and 4 allergic smokers. Table I gives the age, height, weight and pulmonary function of the subjects at the start of the study, grouped according to their smoking habits and history of respiratory allergy. The average smoking history of the smokers at this time was 2 cigarettes a day for 1.9 years. There were no significant differences among the groups, although the flow rates were lower in the allergic group.

Table II shows the increasing prevalence of respiratory allergy and smoking during the course of the study. The number of smokers increased from 15 to 19 while the number of allergic subjects increased from 16 to 23. Among nonsmokers, the number of allergic subjects increased from 12 to 13, while among smokers it increased from 4 to 10.

The figure shows the effects of continued smoking, continued allergy and the combined effects of both on the pattern of lung function change over the four years. These effects were determined

TABLE I: Physical characteristics and pulmonary function of the subjects at the start of the study.

	<i>Nonsmoker non allergic; n = 36</i>	<i>Allergic nonsmokers; n = 12</i>	<i>Smokers non allergic n = 11</i>	<i>Allergic smokers n = 4</i>
	<i>Mean ± SD</i>	<i>Mean ± SD</i>	<i>Mean ± SD</i>	<i>Mean ± SD</i>
Age, yr	18.8 ± 1.30	18.7 ± 0.98	19.8 ± 1.63	19.4 ± .64
Height, cm	171.3 ± 4.44	170.9 ± 6.08	168.6 ± 4.22	168.9 ± 3.27
Weight, kg	59.7 ± 7.64	60.9 ± 6.45	59.4 ± 6.16	63.1 ± 5.19
FVC, l	3.95 ± 0.54	3.9 ± 0.66	3.74 ± 0.57	4.03 ± 0.16
FEV_1 l	3.38 ± 0.46	3.2 ± 0.66	3.30 ± 0.53	3.41 ± 0.20
$FEV_1\%$	85.9 ± 6.95	81.7 ± 8.16	87.6 ± 4.43	84.8 ± 4.35
FEF 25-75 %, l/sec	3.93 ± 0.99	3.40 ± 1.44	3.98 ± 1.02	3.80 ± 0.75
PEF, l/min	522 ± 61.5	487 ± 65.5	499 ± 33.1	522.5 ± 20.68
FEF/FVC	1.01 ± .267	0.87 ± .292	1.06 ± .214	.94 ± 0.186

TABLE II : Incidence of smoking and respiratory allergy in the three serial studies.

	Smokers			Nonsmokers		
	1st study	2nd study	3rd study	1st study	2nd study	3rd study
Allergic						
Number of subjects	4	7	10	12	14	13
Duration of smoking (years)	2.9	3.2	4.3			
Cigarettes smoked per day	3	4	4			
Nonallergic						
Number of subjects	11	9	9	36	33	31
Duration of smoking	1.6	2.7	3.2			
Cigarettes smoked per day	1	5	4			
% allergic	27	44	53	25	30	30

by comparing the pulmonary function of the three groups in the third study with those in their first and second studies respectively. The decline in FEV₁%, FEF 25-75% and FEF/FVC seen in this age group, is greater than normal among the smokers and the allergic subjects.

TABLE III : Influence of FHA and a personal habit of smoking on the natural history of respiratory allergy. (Number of allergic subjects and total number given in each group)

	FHA + n = 29		FHA - n = 34	
	Smokers	Nonsmokers	Smokers	Nonsmokers
1st study	2/7	11/22	2/8	1/26
2nd study	4/7	13/22	3/9	1/25
3rd study	7/10	12/19	3/9	1/25

FHA - Family history of allergy

The influence of a family history of allergy (FHA) and a personal habit of smoking on the natural history of respiratory allergy in this population is seen in Table III. In the group which had both, the incidence of allergy had more than double over the four years of the study. A test of association (X²) between smoking and changing incidence of allergy, was significant (p<.01). The data also shows that three subjects with FHA had

taken up smoking, while only one with no FHA had done so.

DISCUSSION

This study shows that in this age group, over a period of 4 years, the normal subjects show an increase in height, FVC and PEF, and a decline in flow rates and size compensated flows. Two factors that significantly disturbed this normal pattern of lung function change were smoking and respiratory allergy. They caused changes that were indicative of diminished airway growth and airway narrowing. Flows and size compensated flows (FEV₁% and FEF/FVC) were the most disturbed parameters. Decline in FEV₁%, FEF 25-75% and FEF/FVC in smokers and allergic subjects was more than double that in the normal subjects. Lebowitz et al (1) in a recently published study have observed similar findings. In a longitudinal study of children and adolescents, they found that respiratory symptomatology and smoking were two important factors that influenced growth of lung function.

The incidence of allergy increased progressively over the duration of our study. This may be a reflection of the psychogenic stress to which the student is exposed or there may be environmental factors concerned. Our data also show that there

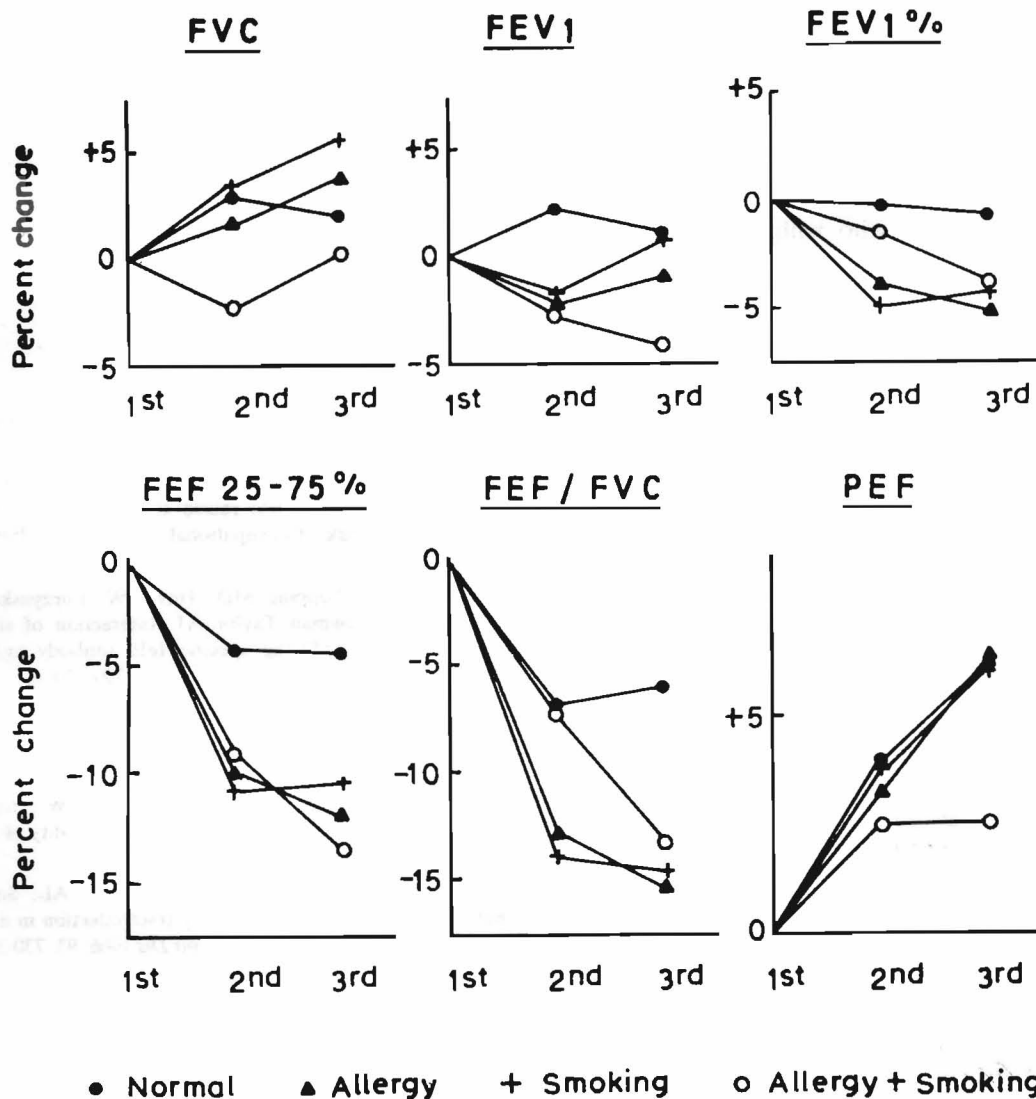


Fig. 1: Percentage change in lung function parameters over the four years, in the four groups of subjects. Three studies were done at intervals of approximately two years.

is a significant interaction between smoking and the manifestation of respiratory allergy. The presence of a smoking habit greatly increased the tendency to develop allergic manifestations in an individual who had an atopic family history. A greater prevalence of respiratory allergies has been reported among smokers (5,6). An interaction between cigarette smoking and atopy has also been demonstrated on IgE antibody levels in the serum

(7,8). Cigarette smokers are reported to be more likely to respond to antigenic challenge than nonsmokers (9). This is probably due to the airway mucosal damage (10) and greater susceptibility to respiratory infections (11) caused by tobacco smoking. These effects can increase antigen access to immuno competent cells and thus cause a greater IgE response and consequently a greater response to antigenic challenge. The findings reported here

emphasize the very early detrimental effects of smoking, on the airways.

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