Original article:

Study of pulmonary function in different age groups

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ABSTRACT :

Introduction: Interpretation of lung function measurements is complicated by the fact that predicted values from the different published studies vary as much as 20% for an individual subjects. Therefore, having local and native prediction equations for PFTs will enhance the reliability of the spirometry performed.

Methodology : Data was collected by randomly selecting in total 200 healthy non-smoking individuals.100 were males and 100 females .The oldest subject was 50 years old & youngest 11 years, mean age being 31 years. They were further subdivided into age groups 11-20, 21-30, 31-40 and 41-50; each group having 50 subjects .Forced vital capacity (FVC), Forced expiratory volume in first second (FEV1), Percentage of ratio between FEV1 and FVC (FEV1 / FVC %), and Peak expiratory flow rate (PEFR) were the criteria used for assessment of pulmonary function. The values of FEV_1, FVC, FEV_1/FVC % and PEFR were observed to be higher in the age group 21-30 than those falling in age group 11-20 indicating the phase of lung growth.

Results: The results showed a decline in all the parameters after the age of 30 which may be attributed to physiological changes of the respiratory system occurring due to ageing.

Key Word s: Pulmonary function test , Forced vital capacity

INTRODUCTION

India is a subcontinent with varying geography and with a large multi-ethnic population. Differences in pulmonary function in normal people may be due to ethnic origin, physical activity, environmental conditions, altitude, tobacco smoking, age, height, sex, and socioeconomic status. The wide range of geographical and climatic conditions in a large country such as India may be associated with regional differences in lung function in healthy individuals, as shown in previous studies.[1] Pulmonary function tests (PFTs) have evolved from tools for physiologic study to clinical tools, widely used in assessing the respiratory status. In addition, they have become a part of routine health examinations in respiratory, occupational, and sports medicine. Normal lung function values and ranges are conventionally calculated according to variables such as sex, age, height, and weight, which contribute independently to predictions of lung function. The prediction equation should ideally be derived from a healthy and representative population tested by standardized technical methods and subjected to appropriate statistical analysis. The value of spirometric testing is influenced to a large extent by the accuracy of predicted normal standards. Many of the older studies still used as reference values fail to meet these criteria. In some studies on the measurement of lung function standards, the population studied included non-smokers, smokers and former smokers. Other factors, e.g. a previous history of respiratory disease, the degree of physical

debility, and exposure to atmospheric pollution, have not always been critically examined. Thus, interpretation of lung function measurements is complicated by the fact that predicted values from the different published studies vary as much as 20% for an individual subject. Some of these variations are due to ethnic differences. Therefore, having local and native prediction equations for PFTs will enhance the reliability of the spirometry performed.[2]

MATERIALS AND METHODS

This prospective study was conducted at one of the tertiary hospitals in Mumbai. The participants of the study were subjects between 11- 50 years of age. Before proceeding for the study, the required proforma & plan of the study were submitted to the Ethics committee For Research on Human Subjects of the institute & were approved. In all, a total number of 200 subjects were selected for the study. They were further divided into sub-groups

Age Groups (Yrs)	Male	Female	Total
11-20	25	25	50
21-30	25	25	50
31-40	25	25	50
41-50	25	25	50

Data was collected by randomly selecting in total 200 healthy non-smoking individuals who met the inclusion criteria and completed the pulmonary function tests (PFT). Both males and females were recruited for the study. The rest of the subjects who were not able to perform the PFT correctly or did not meet the inclusion criteria were excluded. Participants were recruited from various aspects of life, either students or employees of organization. Body measurements were taken, including the standing height and weight. All subjects were non smokers with no history of symptoms of cardiovascular or respiratory diseases that required treatment. Subjects who had recovered from common cold at least one month prior to the study were allowed to participate.

Inclusion Criteria:

Both male and female subjects were included in this study.

The participants were 11 to 50 years of age.

The participants gave proper consent were included.

The participants having normal cardiac and respiratory functions (as assessed by clinical examination) were included.

The participants who didn't have any acute illnesses like upper respiratory tract infection, lower respiratory tract infection, etc were included.

Non- smokers were included.

Exclusion Criteria:

The participants having respiratory problems such as bronchial asthma, Chronic Obstructive lung disease, Tuberculosis, Post Tuberculosis sequelae, etc. were excluded. The participants having valvular heart disease were excluded. The participants who had undergone any abdominal surgery. The participants with acute illness. Smokers were excluded.

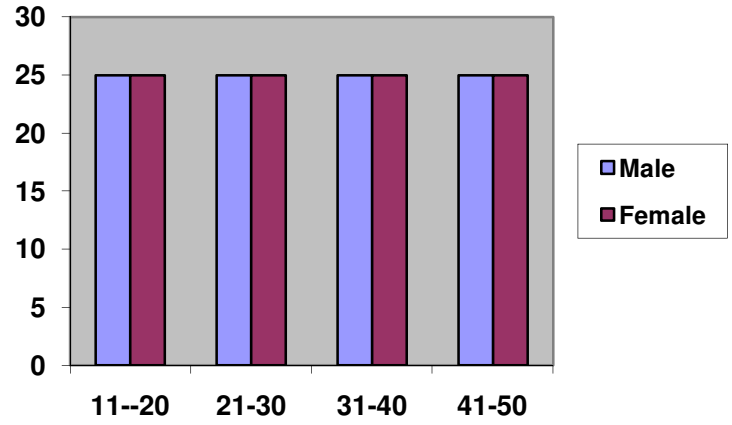
The female participants with pregnancy were excluded. BMI not ranging between 17 and 25.

Subjects suffering from any respiratory disorder for which treatment was taken in past 4 weeks.

The Pulmonary function tests were performed on computerized Pulmonary Function Test machine "BREEZE SUITE 6.2" manufactured by MED-GRAFICS (CPFS/D USB MedGraphics preVent™ Pneumotach). The tests selected for the assessment of the Pulmonary Function were: Forced vital capacity (FVC), Forced expiratory volume in first second (FEV1), Percentage of ratio between FEV1 and FVC (FEV1 / FVC %), and Peak expiratory flow rate (PEFR). The data entry was done in MS-EXCEL and analysis was done. The Mean was used for describing parameters. ANOVA test was used to compare FEV1, FVC, FEV1/FVC and PEFR between the different age groups. The 'p' value < 0.05 was considered as significant.

RESULTS

Distribution: Age and Gender wise



The study procedure was carried out on 200 subjects, out of which 100 subjects were males and 100 were females. They were further subdivided into age groups 11-20, 21-30, 31-40 and 41-50; each group having 50 subjects.

Comparison

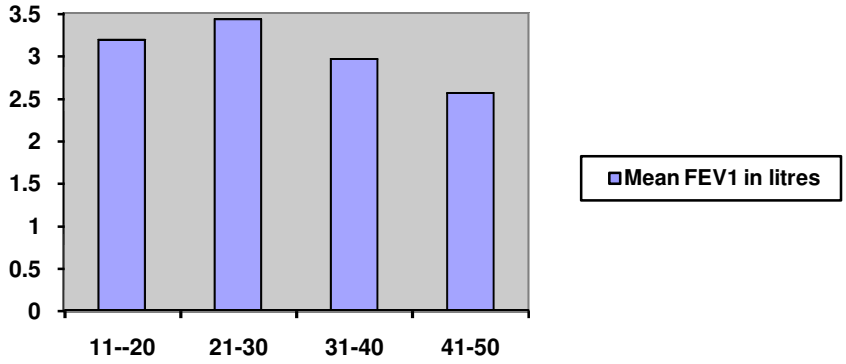
i) FEV1 in different age groups

Age Groups	No. of subjects (n)	Mean FEV1 in liters	Standard Deviation	95% confidence interval for mean
11-20	50	3.19	0.819	2.988 - 3.393
21-30	50	3.43	0.885	3.225 - 3.631
31-40	50	2.96	0.632	2.755 - 3.160
41-50	50	2.56	0.509	2.354 - 2.760

Source of variation	Sum of squares	d.f	Mean squares	F
between	20.65	3	6.884	13.03
Error	103.5	196	0.5282	
total	124.2	199		

'p' value <0.05.

The four age groups were compared for FEV1 by ANOVA test. The probability of this result, assuming the null hypothesis by ANOVA test is less than 0.05, i.e., the „p" value is less than 0.05, hence statistically significant.

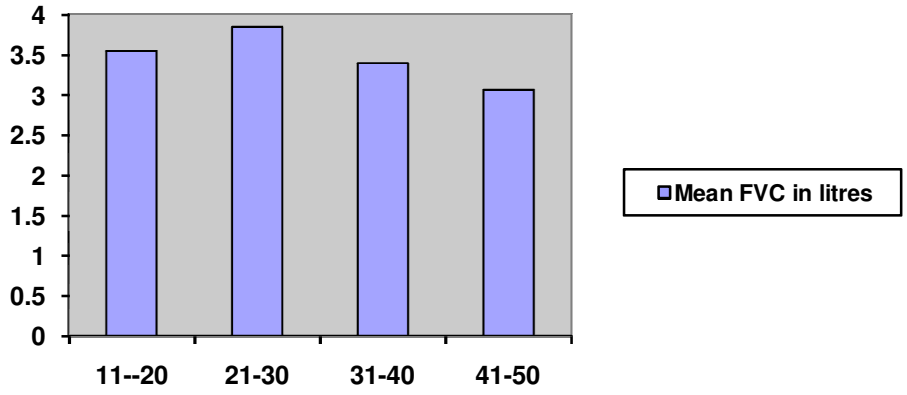


ii)FVC in different age groups

Age Groups	No. of subjects (n)	Mean FVC in litres	Standard Deviation	95% confidence interval for mean
11-20	50	3.54	0.192	3.319 - 3.769
21-30	50	3.84	0.959	3.612 - 4.062
31-40	50	3.39	0.700	3.165 - 3.615
41-50	50	3.06	0.602	2.836 - 3.286

Source of variation	Sum of squares	d.f	Mean squares	F
between	15.66	3	5.221	8.024
Error	127.5	196	0.6506	
total	143.2	199		

The four age groups were compared for FVC by ANOVA test. The probability of this result, assuming the null hypothesis by ANOVA test is less than 0.05, i.e., the 'p' value assuming the null hypothesis is less than 0.05, hence statistically significant.

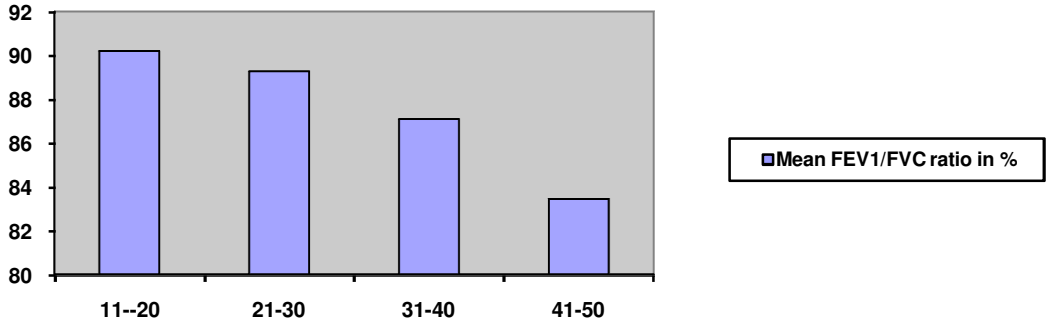


iii)FEV1/FVC in different age groups

Age Groups	No. of subjects (n)	Mean FEV1/FVC ratio in %	Standard Deviation	95% confidence interval for mean
11-20	50	90.18	4.49	89.16 - 91.20
21-30	50	89.26	4.23	88.24 - 90.28
31-40	50	87.08	2.69	86.06 - 88.10
41-50	50	83.46	2.79	82.44 - 84.48

Source of variation	Sum of squares	d.f	Mean squares	F
between	1339	3	446.3	33.63
Error	2601	196	13.27	
total	3940	199		

The four age groups were compared for FEV1/FVC % by ANOVA test. The probability of this result, assuming the null hypothesis by ANOVA test is less than 0.05, i.e., the 'p' value assuming the null hypothesis is less than 0.05, hence statistically significant.

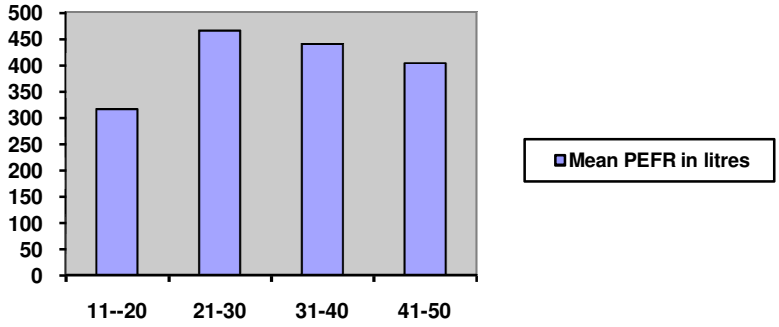


iv) PEFR in different age groups

Age Groups	No. of subjects (n)	Mean PEFR in litres	Standard Deviation	95% confidence interval for mean
11-20	50	315.6	61.4	290.8 - 340.3
21-30	50	464.9	102	440.1 - 489.6
31-40	50	439.7	92.2	415.0 - 464.5
41-50	50	403.1	93.8	378.4 - 427.9

Source of variation	Sum of squares	d.f	Mean squares	F
Between	6.3939	3	2.1313	27.06
Error	1.5438	196	7877	
Total	2.1832	199		

The four age groups were compared for PEFR by ANOVA test. The probability of this result, assuming the null hypothesis by ANOVA test is less than 0.05, i.e., the „p" value assuming the null hypothesis is less than 0.05, hence statistically significant.



DISCUSSION

Pulmonary function tests (PFTs) have evolved from tools for physiologic study to clinical tools widely used in assessing the respiratory status. In addition, they have become a part of routine health examinations in respiratory, occupational, and sports medicine. The study was performed to assess the pulmonary function of healthy non-smoking subjects of different age groups. The study groups were uniformly divided into 4 age groups, each containing 50 subjects. In all, 200 subjects were recruited for the study and they were divided in age groups as 11-20, 21-30, 31-40 and 41-50. Further, in each age group 25 males and 25 females were included. The pulmonary functions of the subjects were assessed for the following parameters:

• Forced expiratory volume in first second (FEV1),

• Forced vital capacity (FVC),

• Percentage of ratio between FEV1 and FVC (FEV1 / FVC %), and

• Peak expiratory flow rate (PEFR).

In the present study, it was observed that the mean values of FEV1 vary significantly in the different age groups as shown in table (i). It was observed that the values in age group 21-30 years were more than that of the age group 11-20 years signifying the stage of lung growth. Subsequently, values of FEV1 and FVC started declining in the age groups 31-40 and the values still declined in the age group 41-50 as compared to that of age group 31-40. The mean values of FVC in the 4 age groups are shown in table (ii). It was seen that the values vary significantly in the different age groups. It was observed that the values in age group 21-30 years were more than that of the age group 11-20 years signifying the stage of lung growth. Subsequently, values of FEV1 and FVC started declining in the age groups 31-40 and 41-50 as compared to that of age group 21-30. The results obtained were similar to the study performed by Knudson et al which also stated that Forced Expiratory Volume in one second (FEV1) and Forced Vital Capacity (FVC) increase up to ~20 yrs of age in females and 27 yrs of age in males, then diminish with advancing age.[3] A comparison with the study of Crapo et al is most appropriate since they were the only other investigators to use a sample of lifetime non smokers. than 10 μm in size.[4],[5]

Increased rigidity of the chest wall and a decrease in respiratory muscle strength with aging result in a decreased FEV1 and FVC. than 10 μm in size.[6] According to European Community for Coal and Steel data, no significant changes occur in forced expiratory volume in 1 second (FEV1) or forced vital capacity (FVC) between the ages of 18 and 25. After this plateau, FEV1 and FVC start to decrease, although more recent studies excluding smokers suggest a later start of FEV1 and FVC decline in non smokers. than 10 μm in size.[7] The mean values of FEV1/FVC % ratio in different age groups are shown in table (iii). It was observed that the values declined in each age group, i.e., as the age advances, the FEV1/FVC percent ratio also decreases. The values obtained were comparable to the study performed by Gore CJ et al which was done in asymptomatic lifetime non-smokers. than 10 μm in size.[8]

The mean values of PEFR in different age groups are shown in table (iv). It was observed that the mean values were maximum in the age group 21-30 and then the values appear to decline. The mean PEFR was lower in age group 31-40 as compared to age group 21-30 and the mean PEFR in age group 41-50 was further decreased than age group 31-40.

The results obtained were similar to the study done by Udwadia FE and et al which stated that the beginning of decline of lung function parameters has been reported to begin at about 30 years of age in both males and females. than 10 μm in size.[9] The mean values obtained were similar to the Indian study by Dikshit MB et al than 10 μm in size.[10] Hence, it was concluded that the values of FEV1, FVC, FEV1/FVC ratio and PEFR decline as the age advances. Normal aging results in changes in pulmonary mechanics, respiratory muscle strength, gas exchange, and ventilatory control.

CONCLUSIONS

- The values of FEV_1, FVC, FEV_1/FVC % and PEFR were observed to be higher in the age group 21-30 than those falling in age group 11-20 indicating the phase of lung growth.
- The results showed a decline in all the parameters after the age of 30 which may be attributed to physiological changes of the respiratory system occurring due to ageing.

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