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Original Research Article

Prospective Observational Study to Establish the Effect of age On Lung Function test of Healthy Non-Smokers

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Abstract

Aim: The present study was done with an aim to establish the age effect on lung function test of healthy non-smoking people belonging to the rural region.

Methods: A prospective study was conducted on 240 patients attending the OPD in Government medical college, Bettiah, Bihar, India for the period of one year. Both male and female subjects with age ranging from 11 to 60 years (and above), non-smoking individuals with normal cardiac and respiratory functions, meeting the inclusion criteria and completing the pulmonary function tests (PFT), were selected.

Results: Out of the total subjects studied, 132 were males and 82 females, with group B having maximum number of males (28). Younger group, i.e., 11-20 years group has a high value for FEV1. As is evident from data analysis, the mean values of FEV1 showed almost a linear relation with ageing, with a small bending of curve between group A and group B. PEFR showed a rise among group A and B (11-20; 21- 30), reaching 7.20±1.70 (L/sec) for group C (31-40 years), and then showed a significant decline reaching to 3.90±0.98 (L/sec) for the age group F, i.e., >60 years.

Conclusion: Considerable differences in the respiratory patterns of healthy individuals and the elderly, suggest that age actually impacts the lung function. Understanding these changes helps detect and prevent the respiratory dysfunctions in the elderly.

Keywords: Pulmonary function test, Lung functions, Forced vital capacity, Forced expiratory volume, Peak expiratory flow rates

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 the study by Vijayan VK. [1] 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. [2] 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.

Ageing is associated with progressive decline in functional reserve of body organs. There is a variation in physiological measures among older adults, necessitating the defining of population-specific "normal" limits and to differentiate the normal from a diseased state. [3] Respiratory muscle strength decreases with age as the lung matures by age 20-25 years, and thereafter ageing- related digression, like decline in lung-function is set off. Differences in pulmonary function or function of the lungs, in normal people may be due to ethnic origin, physical activity, environmental conditions, altitude, tobacco smoking, age, height, gender and socioeconomic status. Studies in India have shown associations with regional differences in lung function in healthy individuals. [4]

The respiratory system changes with age and understanding these changes helps to detect and prevent respiratory dysfunction in the elderly. Lung functions decline throughout adult life, and healthy people are no exception. Normal aging has shown results corresponding to significant changes in pulmonary, mechanics, respiratory muscle strength, gas exchange and ventilator control. [5] Ventilator function tests provide a better understanding of functional changes in the lungs and their significance from the view point of diagnosis. The knowledge of pulmonary function tests is a basic requirement to understand the respiratory physiology for all medical physiologist and clinicians. [6] Pulmonary function tests are an important tool for the diagnosis of pulmonary diseases and in assessing the effect of drug and follow-up of the disease prognosis. It may be affected by many factors like age, gender, race and body surface area of an individual. [7]

The present study was done with an aim to establish the age effect on lung function test of healthy non-smoking people belonging to the rural region.

Materials and Methods

A prospective study was conducted on 240 patients attending the OPD in Government medical college, Bettiah, Bihar, India for the period of one year. Both male and female subjects with age ranging from 11 to 60 years (and above), non-smoking individuals with normal cardiac and respiratory functions, meeting the inclusion criteria and completing the pulmonary function tests (PFT), were selected. Subjects were recruited from various aspects of life, either students or employees of organization and were divided in six groups depending on their age: 11-20, 21-30, 31-40, 41-50, 51-60 and >60 years of age. 30 subjects were included in each group.

Inclusion Criteria

Inclusion criteria for the study included the participants didn't have any acute illness like upper/lower respiratory tract infection, Healthy, asymptomatic, non-obese, with moderate built individuals with non-sedentary life style, Non-smokers having normal cardiac and respiratory functions (as assessed by clinical examination), the participants who didn't have any acute illnesses like upper respiratory tract infection, lower respiratory tract infection, etc. were included. Only the participants who gave proper consent were included.

Exclusion Criteria

The participants having respiratory problems such as bronchial asthma, Chronic obstructive lung disease, Tuberculosis, Post tuberculosis sequelae, etc. The subjects with history of or evidence of respiratory and cardiovascular disease, alcohol and drug abuse and thoracic, spinal and muscular deformity, the participants having valvular heart disease, the participants who had undergone any abdominal surgery and the female participants with pregnancy were excluded. All smokers, BMI not ranging between 17 and 25 and all such subjects who were not able to perform the PFT correctly were not included. Due consent was taken from all the participants before conducting the study. Body measurements of all participating individuals were taken, including the standing height and weight.

Pulmonary function tests

Following pulmonary function tests conducted: Forced vital capacity (FVC), forced expiratory volume in 1st second (FEV1), ratio of FEV1 to FVC expressed in percentage (FEV1/FVC), peak expiratory flow rates (PEFR), Forced expiratory flow rates during 25-75% of expiration (FEF25-75%), and were measured using computerized spirometer (Spiro excel, Medicare systems).

The test was applied at least three times and highest values were recorded. The data was analyzed on MS excel 2010 software to ascertain mean, standard deviation, p value and f value. One-way ANOVA was used to determine the statistical difference among various parameters. A p value of <0.01 was considered significant.

Results

Table 1: Demographic distribution of subjects

11-20 years	N
Male	25
Female	15
Total	40
21-30 years	N
Male	28
Female	12
Total	40
31-40 years	N
Male	20
Female	20
Total	40
41-60 years	N
Male	18
Female	22
Total	40
51-60 years	N
Male	27
Female	13
Total	40
>60 years	N
Male	14
Female	26
Total	40

It is very evident from the earlier studies done in this regard that forced vital capacity decreases with age and its values are significantly lowered with increasing age and inversely related to it. Out of the total subjects studied, 132 were males and 82 females, with group B having maximum number of males (28).

Table 2: Mean values of PFT by ANOVA test.

Group	11-20	21-30	31-40	41-50	51-60	>60	
Respiratory Parameters	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	P value
FVC (L)	3.32±0.80	3.38±0.52	3.16±0.54	2.75±0.65	2.36±0.74	2.26±0.45	<0.01
FEV1 (L)	3.03±0.70	3.08±0.84	2.90±0.42	2.57±0.83	2.05±0.65	1.9±0.77	<0.01
FEV1/FVC (as %)	90.12	91.29	92.88	85.45	88.99	83.87	<0.01
PEFR (L/sec)	5.55±1.15	6.90±1.50	7.20±1.70	6.08±1.65	5.89±1.46	3.90±0.98	<0.01
FEF25-75% (L/sec)	3.70±0.70	4.56±1.01	4.75±1.25	4.05±1.17	3.64±0.87	2.40±0.73	<0.01

Younger group, i.e., 11-20 years group has a high value for FEV1. As is evident from data analysis, the mean values of FEV1 showed almost a linear relation with ageing, with a small bending of curve between group A and group B. PEFR showed a rise among group A and B (11-20; 21- 30), reaching 7.20±1.70 (L/sec) for group C (31-40 years), and then showed a significant decline reaching to 3.90±0.98 (L/sec) for the age group F, i.e., >60 years.

Discussion

Ageing, a universal phenomenon, is not a disease but there occurs general decline, first in functional reserve, then in function over time and the risk of developing disease is increased. [8] The lung matures by age 20–25 years, and thereafter ageing is associated with progressive decline in lung function. The decline in PFTs depends on peak lung function achieved during adulthood. [3] Studies have demonstrated that age-related functional changes in the respiratory system result from: decrease in compliance of the chest wall, strength of respiratory muscles and elastic recoil of the lung. [9] 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.

Major observations recorded including that of mean values of FVC varied significantly with age groups. For age group 11-20 years, it stood at 3.32±0.80 L and for group 21-30 years, it rose to 3.38±0.52 L showing stage of lung growth among these age groups. It showed significant decline with proceeding age groups. A similar trend or a similar graph could be observed for FEV1 values as well. These findings/results were quite similar to the findings of Jagia, Knudson and Vidja et al. [10-12] Lung function does not have a straight-line graphic association with age. It may keep rising from age of 11 years, reaching peak at the age: 20 and then start declining. It has further variability in older people, depending upon lung capacity at maturation time. [13] Observation with respect to FEF25-75% values also showed significant decline with age of a person and more so in patients with age >40 years; and Girgla et al had also made similar findings in 2012. [14]

Generally speaking, our results showed a decline in all parameters, including that of: FVC, FEV1, FEF25-75%, PEFR after the age of 50, while studies like those of Behra and Bandyapadhyay et al had registered similar findings. [15,16] This also means that our study was quite in line with the most of the research findings in the field, but done under a different social set up. Increased rigidity of the chest wall and a decrease in respiratory muscle strength with aging results in a decreased FEV1 and FVC. than 10 μm in size. [17] 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. [18]

Conclusion

Considerable differences in the respiratory patterns of healthy individuals and the elderly, suggest that age actually impacts the lung function. Understanding these changes helps detect and prevent the respiratory dysfunctions in the elderly. We can measure the pulmonary function tests by spirometry which is an important predictor of morbidity and mortality of elderly persons. In addition, these tests have to become a part of routine health examinations in elderly population, people under respiratory distress, occupational monitoring and essentials in sports medicine.

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