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Research article

A STUDY OF CHANGES IN PULMONARY FUNCTION WITH ADVANCING AGE AND THE EFFECT OF SMOKING IN MALES OF NORTH KERALA

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ABSTRACT: As the life expectancy is rising virtually in all proportions throughout the world, awareness of the basic changes in respiratory physiology associated with aging and their clinical implication is important for clinicians. Similarly Chronic obstructive pulmonary disease has emerged as a major health condition worldwide and cigarette smoking has been clearly documented as a risk factor for it. We made an attempt to assess the changes in the pulmonary function with age and also to assess the effect of smoking in males of 18-85 years from North Kerala . The pulmonary function tests were assessed on a computerized spirometer in 247 male subjects, out of which 127 were nonsmokers and 121 were smokers . The results showed a strong negative correlation between various age groups indicating a statistically significant decrease in all pulmonary function parameters as age increases($p<0.01$). All the pulmonary function parameters were also significantly decreased in smokers when compared to nonsmokers of the same age groups ($p<0.01$). The percentage of smokers having airflow limitation (33.1%) was more than 5 times that of the nonsmokers (5.6%). Thus by spirometry airflow limitation can be measured at an early stage so that subsequent morbidity can be minimized by life style changes and more targeted smoking cessation programmes.

Key words- pulmonary function, spirometry, chronic obstructive pulmonary disease

INTRODUCTION

Respiratory diseases are responsible for a large proportion of premature mortality and serious morbidity among the population. The infectious diseases prevalent in 1900 have given way to chronic life style diseases by the year 2000. Chronic obstructive pulmonary disease is an unremitting disease characterized by a decline in lung function over the time and insidiously progressive respiratory disability. It includes emphysema and chronic bronchitis and smoking is a well known risk factor for it. It is currently the fourth leading cause of death in the world and further increase in the prevalence and mortality of the disease can be predicted in the coming decades (GOLD 2004). In the global burden of disease study conducted under the auspices of World Health Organization and World Bank, the world wide prevalence of chronic obstructive pulmonary disease in 1990 was estimated to be 9.34/1000 in men and 7.33/1000 in women for all age groups.(Murray CJL etal,1997). Even in individuals who enjoy apparently good health there are measurable decrements of function of the respiratory system with age. Physiological reserve especially for alveolar exchange is reduced with aging. This leaves elderly individuals vulnerable to stresses, diseases and injuries that are weathered much more easily in the young.(Janssen J P etal, 1999).

Structural and physiologic changes associated with aging begin in the 3rd decade of life and result in a slow decline in lung function. They include increased size of the bronchioles, alveolar ducts and alveolar sacs, decreased diameter of small airways, respiratory muscle strength, lung elastic recoil & chest wall compliance (Camhi SL etal 2000). The extent to which these changes are caused by normal aging can be difficult to assess. Cigarette smoking obviously affects lung function. At least 95% of people who develop chronic obstructive pulmonary disease are smokers and their lung function decreases faster than that of nonsmokers(Schayck CP Van etal 2002) . Symptoms of chronic cough and phlegm production may develop soon after commencement of smoking habit. Symptomatic airflow obstruction usually does not become apparent until after 20 or 30 years of smoking or after the age of 50(Verma S S et al, 2002). Spirometry is the most basic and frequently performed test of pulmonary function. It has role in diagnosis and management of respiratory illness such as asthma, COPD, restrictive lung disorders and is important in the assessment of lung health in smokers and those exposed to occupational and environmental hazards and to assess the effect of medications and to measure progress in disease treatment. Thus it is used routinely to evaluate patients who have or who are at risk of developing respiratory diseases. The early identification of susceptible smoker could lead to more targetted smoking prevention or smoking cessation programmes. Eventhough the smokers who quit will not recover lost lung function, the rate of decline may revert to that of a nonsmoker(Schayck CP Van etal 2002) Stopping smoking at an early stage improves the prognosis regardless of how many attempts it takes to quit. Eventhough there are many studies reported from India and different parts of the world , there is no such study in which we get data about both nonsmokers and smokers in such a wide age group in a single study. We therefore did a study to assess the changes in pulmonary functions in healthy nonsmokers of different age groups belonging to North part of Kerala and the effects of smoking on pulmonary function in the same age groups.

MATERIALS AND METHODS

The present cross sectional study was conducted in Institute of Chest Diseases attached to the Government Medical College, Kozhikode , Kerala. The study population included 247 male subjects comprising of 121 smokers and 126 non smoker controls aged between 18-85 years who were from Calicut,Wayanad, Malappuram ,Kannur and Kasaragod districts as the drainage area of Calicut medical college includes these districts and we have taken the healthy bystanders and visitors of the patients and medical students from these regions as subjects. The subjects were divided into 18-24 years, 25- 35years, 36-45 years, 46-55 years, 56-65 years and more than 65 years.

Inclusion criteria: Individuals aged between 18-85 years with history of smoking cigarettes/bidis daily for at least one year were considered as smokers.

Exclusion criteria: All subjects were examined and those with any disease of respiratory system or any other systemic illness were excluded from the study. Also ex-smokers or past smokers were excluded from the study.

Anthropometry

The subjects were subjected to anthropometry at the point of entry using the standard procedures and instruments. Age was recorded from birthday by calendar to the nearest of year (<6 months and >6 months). Standing height was recorded without shoes and with light clothes on a wall mounted measuring tape to the nearest of centimeters (<5 mm and >5 mm). Weight was recorded without shoes and with light cloths on a weighing machine. Body mass index was calculated by the formula of weight (in kg) and height (in meters). BMI = Weight (kg)/ (height in m2).

Respiratory Parameters:

Pulmonary function tests were done by a computerized spirometer ('Micro Quark'). After rest for 5–10 min and briefing to the technique FVC (maximum inhalation followed by maximum exhalation & to be sustained until asked to inhale again), the test was carried out in a private and quiet room, between 9.30 to 11.30 a.m. to rule out any diurnal variation and in sitting posture with the nose clip held in position on the nose. The flow, volume/timed graphs were taken out and best of the three acceptable curves was selected as the recording.

Statistical analysis : Means and standard deviations of all the sets of observations were calculated . In nonsmokers, analysis of various parameters also done by test of correlation to find out the association between pulmonary function and age. Co efficient of correlation(r) is calculated and test of significance for correlation coefficient applied and p value of <0.05 is taken as significant. In smokers Unpaired students t test is applied. P value <0.05 is taken as significant.

RESULTS

In the present study it was observed that there was no significant difference in the mean physical parameters like age, height, weight, and body surface area by calculating mean and standard deviation in smokers and non-smokers, though Body Mass Index was slightly lower in smokers. Most of the smokers smoked only cigarettes (66.0%) followed by both cigarette and bidis (20.0%) and only bidis (14.0%).

In nonsmokers, vital capacity, forced vital capacity, forced expiratory volume in the first second, FEV1/FVC ratio, peak expiratory flow rate and maximum voluntary ventilation were highest in the 18-24 age group. As age advances all the pulmonary function showed a definite decline in healthy nonsmokers (r= -0.97, p=<0.01) (Table 1, figure1). There was no significant change in the PEFR of nonsmokers and smokers of 18-24 age group. But a significant decline in Peak expiratory flow rate was seen in smokers of 25 to 85 years of age when compared to nonsmokers. All the Pulmonary function tests like FVC, FEV1, FEV1/FVC, PEFR, and MVV showed statistically highly significant association between smokers and nonsmokers by applying unpaired t-test of significance (P<0.01) (Table 2,fgure 2). Airflow limitation was noted in 33.1% of the smokers and 5.6% of the nonsmokers aged between 46-85years. There was no airflow limitation in nonsmokers of 18- 45 years of age. (Tables 3, 4).

Table-1.Mean and SD of the pulmonary function tests in nonsmokers of various age groups

	18-24 yrs	25-35 yrs	36-45 yrs	46-55 yrs	56-65 yrs	>65 yrs
VC**	3.68±1.61	3.11±0.44	2.95±0.48	2.64±0.24	2.49±0.28	2.45±0.4
FVC**	3.54±0.5	3.27±0.31	3.07±0.45	2.74±0.3	2.5±0.27	2.43±0.37
FEV1**	3.1±0.44	2.72±0.29	2.46±0.35	2.12±0.22	1.83±0.2	1.74±0.23
PEFR**	7.16±1.34	7.12±0.85	6.49±0.82	6.02±0.53	5.87±0.84	5.57±0.34
FEV1/FVC	87.92±4.82	83.03±3.76	79.9±2.35	77.44±5.2	73.21±2.64	72.33±8.25
MVV***	108.73±12.44	103.44±12.19	91.54±12.55	84.98±8.46	77.69±8.51	71.58±12.32

Test of correlation applied. Coefficient of correlation (r) calculated. All variables showed r of -0.93to-0.98.Test of significance of correlation found out. p<0.05 taken significant. **p<0.01,***p<0.001

Table 2 : Mean and SD of pulmonary function tests in Smokers of various age groups

	18-24 yrs	25-35 yrs	36-45 yrs	46-55 yrs	56-65 yrs	> 65 yrs
VC	2.83±0.4*	2.86±0.4*	2.67±0.5*	2.26±0.4**	2.09±0.4**	1.96±0.3**
FVC	3.11±0.42**	3.07±0.35*	2.85±0.31*	2.37±0.38**	2.25±0.31**	2.11±0.27*
FEV1	2.58±0.26**	2.44±0.33*	2.21±0.28*	1.69±0.25**	1.52±0.27**	1.3±0.15**
PEFR	6.68±0.84	5.76±1.12**	5.18±1.22**	4.37±1.00**	4.07±1.5**	3.85±1.22**
FEV1/FVC	83.39±4.61*	79.51±6.39**	77.77±6.79**	71.99±10.52*	67.99±10.5**	62.02±8.05**
MVV	98.94±11.78*	91.69±13.35**	82.89±9.47**	69.48±12.56**	60.73±11.6**	57.08±10.04**

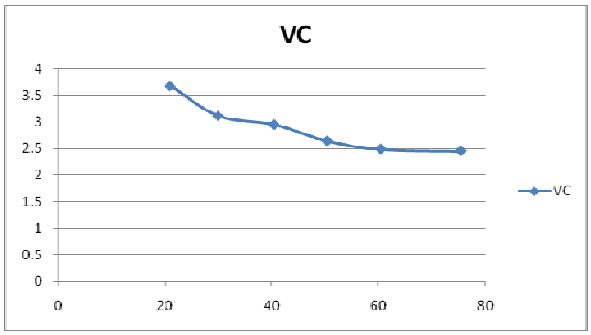
T test applied. p< 0.05 taken significant. *p<0.05 ,**p<0.01

Table 3: Nonsmokers with airflow limitation

	18-24 yrs	25-35 yrs	36-45 yrs	46-55 yrs	56-65 yrs	>65 yrs	total
airflow limitation	0(0%)	0(0%)	0(0%)	1(4.2%)	1(4.6%)	5(35.7%)	7(5.6%)
normal	20(100%)	21(100%)	25(100%)	23(95.8)	21(95.4%)	9(64.3%)	119(94.4%)
total	20(100%)	21(100%)	25(100%)	24(100%)	22(100%)	14(100%)	126(100%)

Table 4: Smokers with airflow limitation

	18-24 yrs	25-35 yrs	36-45 yrs	46-55 yrs	56-65 yrs	>65 yrs	total
Airflow limitation	0(0%)	2(9.5%)	3(12%)	10(41.7%)	15(68.2%)	10(71.4%)	40(33.1%)
Normal	15(100%)	19(90.5%)	22(88%)	14(58.3%)	7(31.8%)	4(27.6%)	81(66.9%)
Total	15(100%)	21(100%)	25(100%)	24(100%)	22(100%)	14(100%)	121(100%)



x axis – shows age in years(midx), y axis –mean VC in litres

Figure 1: Vital capacity (VC) of healthy nonsmokers of different age groups

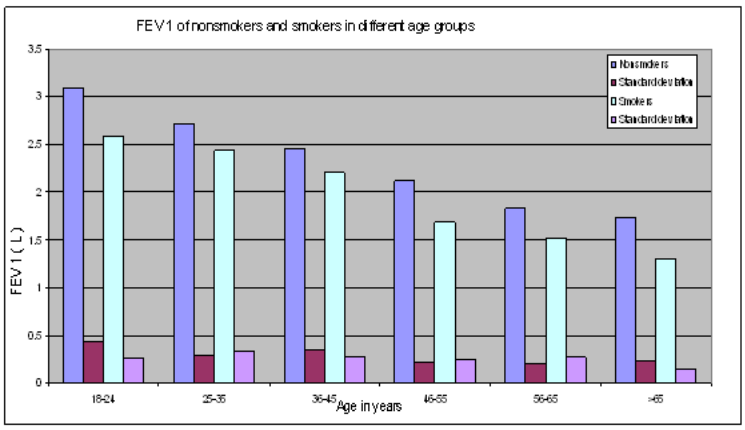


Figure 2

DISCUSSION

In the present study the pulmonary function parameters like VC,FVC,FEV1,FEV1/FVC and MVV in nonsmokers were maximum in the age group of 18-24 years, it showed a considerable decrease in value as age advances (table 1). Similar, observations showing lung function impairment in nonsmokers were also observed in the studies of Verma SS et al (2002), Knudson et al (1983) and CJ Gore et al (1995). The maximum value for PEFR was observed in the age group of 18-24years and slight change was noted in 25-35years. But a significant change in PEFR was seen after 35years. Study of Malik SK et al (1978) and Mahajan KK et al (1984) also showed similar results. But in a study conducted by Natarajan et al(1978) and CJ Gore et al(1995) , the highest value of PEFR was in the age group of 25-35years and significant decline of this value was evident after 45years. A study conducted in healthy inmates of 17-70years of Sri Aurobindo Ashram, Pondicherry over a period of 4 years reported that in the Ashram environment age has a relatively lesser negative influence on pulmonary function. (Virani N etal 2001). Chronic obstructive pulmonary disease is a disease state characterized by airflow limitation that is not fully reversible. Among the persons who develop COPD, about 95% are smokers. According to GOLD report(2004) for the diagnosis and assessment of COPD, spirometry is the gold standard, as it is the most reproducible, standardized and objective way of measuring airflow limitation. Airflow limitation in adult ever smokers is defined by GOLD document as an FEV1/ FVC of less than 70%. In the present study it was observed that there was no significant difference in the mean physical parameters like age, height, weight, body mass index and body surface area thereby showing proper matching of smokers and non-smokers. None of individuals smoked tobacco in any form other than cigarettes or bidis . Most smokers were cigerette smokers (66.0%) may be because in Kerala almost all have studied upto high school and think that smoking cigerettes is more prestigious than smoking beedis. In the present study all Pulmonary function parameters showed statistically highly significant association between smokers and non-smokers by applying unpaired t-test of significance ($P<0.01$). Similar, observations showing lung function impairment in smokers were reported by Burrows et al(1983), Walter S (1992),Tockman M et al (1976) and Kent A Griffith et al (2001). However, several researchers like Angelo etal (1973)and Mahajan B K et al (1983) observed no change in FVC in smokers and non-smokers . FEV1/FVC ratio is the most sensitive and specific test for detecting airflow limitation and a value of less than 70% confirms the presence of airflow limitation. The fall in FEV1, PEFR and other flow rates indicate obstructive lung changes . In the present study airflow limitation is not seen in nonsmokers upto 45years. After 45 years, a small percentage of people showed airflow limitation. In smokers the onset of abnormalities in most of the lung function parameters were found to be as early as the age group of 18-24years. This is in consistent with the study of Beck GJ et al(1981) . Study by Seely JE et al (1971) also showed that deterioration of lung function can be detected as early as 1-2 years after smoking was started . In another study by Bajentri AL et al (2003) it was observed that 2-5 years of tobacco smoking leads to significant lowering of all the lung function parameters. 33.1% of smokers showed air flow limitation which indicates the need of screening of smokers for airflow obstruction and smoking cessation programmes and other other preventive therapies to minimize the hazards of smoking.

CONCLUSION

The pulmonary function tests were assessed on a computerized spirometer in 247 male subjects comprising, 121 smokers and 126 non smoker controls. With increasing age, all the pulmonary functions showed a significant decline. Modification of the age related changes in pulmonary functions can be made possible in a relatively low pollution ambience, a different life style with conscious application of stress management and physical activity as seen in Yoga since several studies on Yoga showed its effectiveness in improving the pulmonary functions, irrespective of the age of the individual. Almost all the pulmonary function parameters were significantly reduced in smokers as compared to non smoker controls and obstructive pulmonary impairment was commonest in smokers. By screening smokers, by computerized pulmonary function testing, the early changes in airflow obstruction may be detected and special emphasis is to be recommended on smoking cessation strategies.

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