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EARLY DETECTION OF COPD BY SPIROMETRY IN ACTIVE MALE SMOKERS

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Abstract: **The COPD (Chronic Obstructive Pulmonary Disease) is predicted to be the third leading cause of death worldwide & fifth leading cause of years lost by premature death or disability by year 2020 as per epidemiological projections. The study was conducted to assess the COPD prevalence among healthy active male smokers by spirometry in a Tertiary Care Hospital in North India.**

Methods: A total of 512 individuals who met the inclusion criteria and given written consent for participation in the study were evaluated by spirometry. Based on spirometry, subjects were classified as having mild COPD (FEV1/FVC <0.70, FEV1>80%of predicted normal value), Moderate COPD (FEV1/FVC <0.70, FEV1 30-50%of predicted normal value), and severe COPD (FEV1/FVC <0.70, FEV1 < 30%of predicted normal value) as per GOLD guidelines.

Results: All the subjects were active male smokers with mean (± SD) age of 42.82 ± 8.68. 304 subjects (59.38%) were more than 40 years of age and 208 (40.62%) were less than or equal to 40 years. Overall airway obstruction was seen in 60 (11.71%) subjects. Mild obstruction (GOLD Stage 1) was seen in 42 (70 %) of the cases that have recorded airway obstruction and 8.20% of the total number of subjects. Moderate obstruction (GOLD Stage 2) in 18 (30%) of the subjects that have recorded airway obstruction and 3.51% of the total number of subjects. In smokers more than 40 years of age and with smoking index more than 200 (n=250), 48 (19.2 %) had obstruction and in smokers less than 40 years of age and smoking index less than 200 (n=160), 05 (3.12%) had obstruction (p<0.005).

Conclusion: It is interfered by present study that early diagnosis of COPD by spirometry, especially in smokers more than 40 years of age and with smoking index of more than 200, is likely to detect COPD by spirometry at an early stage and will positively impact the draining of resources. At present we do not have confirmatory evidence in support of the statement that early diagnosis of COPD may improve the smoking cessation. The best way to reduce the cost of such screening programs is to link spirometry with other screening programs like detection of diabetes, hypertension and other life style diseases in men.

Keywords: **COPD, GOLD, NICE, FEV1, FVC, Smoking INDEX, AGE.**

1. INTRODUCTION

The COPD (Chronic Obstructive Pulmonary Disease) will be the third leading cause of death worldwide & fifth leading cause of years lost by premature death or disability by year 2020 as per epidemiological projections.[1]The standard respiratory test for detection of COPD is spirometry. The spirometry is accepted as the diagnostic test to assess airflow obstruction and classify severity of disease. A high proportion of COPD in community remains undiagnosed, & Early diagnosis optimizes the opportunities to prevent worsening of disease and prevention of comorbidities [(1,2)]. The spirometry testing should focus on those at risk particularly from smoking, spirometry was able to detect unrecognized air flow obstruction in 22% of current smokers aged 35-70 years in Netherlands in one study. There is strong emphasis on smoking cessation in both NICE and GOLD guidelines.[2]

Based on spirometry, the standard measure for defining airway obstruction had been specified as reduction in the ratio of Forced expiratory volume in one second (FEV1) to the forced vital capacity (FVC) from last 50 years. The chronic Obstructive pulmonary disease is defined as a forced expiratory volume (FEV1) to Forced vital capacity ratio (FER <70%) after administration of Bronchodilators. According to literature, COPD has a high prevalence in smokers due to fast evolution and high rate of undiagnosed disease. The screening is especially important due to underestimation of COPD prevalence, late diagnosis due to low detection rate of airflow obstruction and already overburdened health care facilities.[3,4]

The goal of our study was screening of active smokers for early detection of COPD by pulmonary function testing by spirometry who attended the OPD clinic with no complaints or mild symptoms of cough, expectoration, breathlessness. The study aims to early detection of COPD among smokers and motivating them to quit smoking at an early stage and treatment by pharmacological and nonpharmacological means.

What is Chronic Obstructive Pulmonary Disease

As per GOLD guidelines chronic obstructive pulmonary disease (COPD) is defined as common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or smoke. The most common respiratory symptoms include dyspnea, cough &/or sputum production which are mostly unreported by the patients.[2]

The main Risk factor for COPD is tobacco smoking but other environmental exposures such as biomass fuel exposure and airway pollution may contribute. Besides exposures, host factors predispose individuals to develop COPD, which include genetic abnormalities, abnormal lung development & accelerated ageing. COPD may be punctuated by periods of acute worsening of respiratory symptoms called exacerbations.

Prevalence, Morbidity & Mortality of COPD

COPD prevalence, mortality morbidity varies across countries. Existing COPD prevalence data vary widely due to difference in survey methods, diagnostic criteria, and analytic approaches. A systemic review and meta-analysis, including studies carried out in 28 countries between 1990 and 2004, provided evidence that the prevalence of COPD is appreciably higher in smokers and Ex-smokers, in those ≥ 40 years of age compared to those <40, and in men compared to women.[2,3]

The accurate estimates based on standardized population based sampling of adults aged 40 and over in 12 sites in the burden of obstructive lung disease survey indicated an overall COPD prevalence (GOLD stage II or higher, FEV_1 <80% predicated) of 10.1%.

Based on BOLD and other large scale epidemiological studies, it is estimated that the number of COPD cases was 384 million in 2010, with a global prevalence of 11.7% (95% confidence interval (CI) (8.4%-15.0%).[3,4]

Morbidity measures traditionally include physician visits, Emergency Department Visits and Hospitalizations. COPD database for these outcome parameters are less readily available and usually less reliable than mortality database, the studies on available data indicate that morbidity due to COPD increases with age and in patients with developmental comorbidities at an early age. Morbidity from COPD may be affected by other Concomitant chronic diseases (like cardiovascular disease, musculoskeletal impairment, diabetes mellitus) that are related to smoking, ageing & COPD.

Globally, there are around three million deaths annually. With the increasing prevalence of smoking in developing countries and ageing population in developed countries, the prevalence of COPD is expected to rise and by 2030 there may be over 4.5 million deaths annually from COPD and related conditions.[5,6]

Since mortality offers only a limited perspective on the human burden of a disease, it is desirable to find other measures of disease burden that are consistent and measurable within and between nations. The disability adjusted life years (DALY) for a specific condition are the sum of years lost because of premature mortality and years of life lived with disability, adjusted for severity of disability. The Global Burden of Disease (GBD) study found that COPD in an increasing contributor to disability and mortality around the world. In 2005 COPD was the eighth leading cause of DALYs lost across the world but by 2013 COPD was ranked as the fifth leading cause of DALYs lost. [7,8,9]

Pathology, Pathogenesis & Pathophysiology

Inhalation of cigarette smoke or other noxious particles, such as smoke from biomass fuels, causes lung inflammation which is normal response that appears to be modified in patients who develop COPD. The chronic inflammatory response may induce parenchymal tissue destruction resulting in emphysema and disruption of normal repair and defense mechanisms resulting in small airway fibrosis. The pathological changes lead to air trapping and progressive airflow limitation.

Pathological changes characteristic of COPD are found in airways, lung parenchyma and pulmonary vasculature. The pathological changes observed in COPD include chronic inflammation, with increased number of specific inflammatory cell types in different parts of lung and structural changes resulting from repeated injury and repair. The inflammatory and structural changes in the airways increase with disease severity and even persist on cessation of smoking. Systemic inflammation may be present and could play a role in multiple comorbid conditions found in patients with COPD. [2,3,10]

COPD leads to characteristic physiological abnormalities and symptoms, Inflammation and narrowing of peripheral airways leads to decreased FEV1. The extent of inflammation, fibrosis and luminal exudates in small airways correlates with the decline in FEV1 and FEV1/FVC ratio that is characteristic of COPD. The peripheral airway narrowing progressively traps gas during expiration, resulting in hyperinflation. Static hyperinflation reduces inspiratory capacity and is commonly associated with dynamic inflammation during exercise leading to increased dyspnea and limitation of exercise capacity. It is thought that hyperinflation develops early in disease and main mechanism for exertional dyspnea.

Thee abnormalities of Gas exchange for oxygen and carbon dioxide worsens as the disease progresses and results in hypoxemia and hypercapnia. Reduced ventilation may be due to reduced ventilator drive or increased dead space ventilation due to increased effort to breathe because of severe limitation and hyperinflation coupled with ventilator muscle impairment.[2,10]

Pulmonary hypertension may develop late in the course of COPD and is mainly due to hypoxic vasoconstriction of the small pulmonary arteries, eventually resulting in structural changes that include intimal hyperplasia and later smooth muscle hypertrophy/Hyperplasia.

Mucus hypersecretion, resulting in chronic productive cough is a feature of chronic bronchitis and is not necessarily associated with airflow limitation.

Diagnosis & Assessment of COPD

A clinical diagnosis of COPD should be considered in any patient who has Dyspnea, chronic cough and/ or sputum production, and a history of exposure to risk factors for the disease.

Spirometry is accepted as the diagnostic test to assess airflow obstruction and classify severity of disease. Spirometry is required to make the diagnosis, the presence of a post bronchodilator FEV1/FVC less than 0.70 conforms the presence of persistent airflow limitation and thus of COPD. [3,4,14]

The Goals of COPD assessment are to determine:

1. The impact of disease on patient's health status.
2. The severity of airflow limitation.
3. The risk of future exacerbations, in order to guide therapy.

The risk of future exacerbations is estimated by the severity of airflow limitation and history of previous exacerbations. An exacerbation of COPD is defined as an acute event characterized by a worsening of the patient's respiratory symptoms that is beyond day to day normal variation and leads to changes in medication.[2,11,12]

Severity of Exacerbations is usually classified as mild when exacerbations of respiratory symptoms require change of inhaled treatment by the patient, moderate when exacerbations of respiratory symptoms require medical intervention including a short course of antibiotics and/ or oral steroids and severe when exacerbations of respiratory symptoms Require Hospitalization.[13,14]

Comorbidities including, cardiovascular disease, skeletal muscle dysfunction, metabolic syndrome, osteoporosis, Depression and lung cancer occur frequently in patients with COPD. Comorbidities should be actively looked for and treated appropriately if present.

GRADING OF SEVERITY OF AIRFLOW LIMITATION IN COPD

Based on post bronchodilator FEV1

In patients with FEV1/FVC < 0.70		
GOLD 1	Mild	FEV1 ≥ 80% Predicted
GOLD 2	Moderate	FEV1 ≥50 & < 80% predicted
GOLD 3	Severe	FEV1 ≥ 30 & < 50% predicted
GOLD 4	Very Severe	FEV1 < 30% predicted

2. METHOD & MATERIALS

The study was conducted on active smokers at OPD clinic in a tertiary care hospital in north India after getting their informed consent to participate in the study. In the prospective cross sectional study Total 512 patients were enrolled over the three-year period from July 2003 to June 2006 who were active smokers and consented to participate in the study.

Inclusion Criteria

1. Age group 35 to 50 years
2. Active smokers who are smoking Index >100.
3. Presenting in OPD with no or one mild symptom like cough &/or expectoration, breathlessness.

Exclusion Criteria:

1. Diagnosed cases of COPD or Chronic Bronchitis
2. Having pneumothorax < 6 months' back
3. Other comorbities Hypertensive, Diabetes Mellitus
4. Age < 35 years & >50years

According to Age patients were divided in three Groups:

1. Group I: ≤40 years
2. Group II: >40 years

Based on smoking index: Smoking index is a parameter used to express commutative exposure quantitatively. This is useful in defining risk ration of a smoking related disease. In a country like ours where a pack of cigarettes contains either ten or twenty cigarettes and smoking habits include either cigarette or bidi smoking, smoking index is more appropriate than pack years. In comparative terms, 10 pack years is equivalent to smoking index of 200 (smoking index= pack year×20).

If a person is smoking 20 cigarettes or bidis per day and from last ten years then his smoking index will be 20×10 =200, if a person is smoking 15 cigarettes per day from last 20 years, his smoking index will be 15×20 =300.

1. Group I: ≤ 200
2. Group II: > 200

All the subjects were briefed about the aim of the study, after getting their consent to participate in the study. They were also apprised regarding the harmful effects of smoking in causing COPD and how it remained undetected in initial stage clinically and with the help of spirometry disease can be detected at an early stage. They were taught how cessation of smoking can halt the progression of the disease.

All the consenting participants were subjected to spirometry using a portable spirometer. Spirometry was performed by experienced paramedic or respiratory nurse as per the recommendation of American Thoracic Society. The patients with abnormal spirometry results were advised to report for further evaluation and management & smoking cessation program.

The following parameters were recorded for each patient, i.e. Age, sex, smoking index, any active symptoms and vitals were recorded. FVC, FEV1 & FEV1% were measured after administration of 400 µg of salbutamol as per guidelines given by GOLD.

Based on spirometry, subjects were classified as having mild COPD (FEV1/FVC <0.70, FEV1>80%of predicted normal value), Moderate COPD (FEV1/FVC <0.70, FEV1 30-50%of predicted normal value), and severe COPD (FEV1/FVC <0.70, FEV1 < 30%of predicted normal value) as per GOLD guidelines.[2,7]

Statistical Analysis

Descriptive statistics for recorded parameters were calculated by using means ± SD. The Chi square test was applied to find out the significance.

3. RESULTS

A total of 512 individuals who met the inclusion criteria and given written consent for participation in the study were evaluated by spirometry. All the subjects were males with mean (± SD) age of 42.82 ± 8.68. 304 subjects (59.38%) were more than 40 years of age and 208 (40.62%) were less than or equal to 40 years (Figure 1).

All subjects were cigarette smokers with smoking index of 422.69 ± 198.34 in individuals (n=304) more than 40 years of age and 231.84±104.29 in individuals less than or equal to 40 years of age (208) (Table 1).

The percentage of patients according to smoking index, it was observed that out of 512,

344 (67.1%)subjects were having smoking index >200 and 168 (32.9%) subjects have smoking index ≤ 200 (Figure 2).

Table 1: Distribution of patients as per age and smoking index

Age (%)	*N (%)*	*SI*	*n (%)*
>40 Yrs.	304 (59.38%)	>200	344 (67.1%)
≤ 40 Yrs.	208(40.62%)	≤ 200	168 (32.9%)

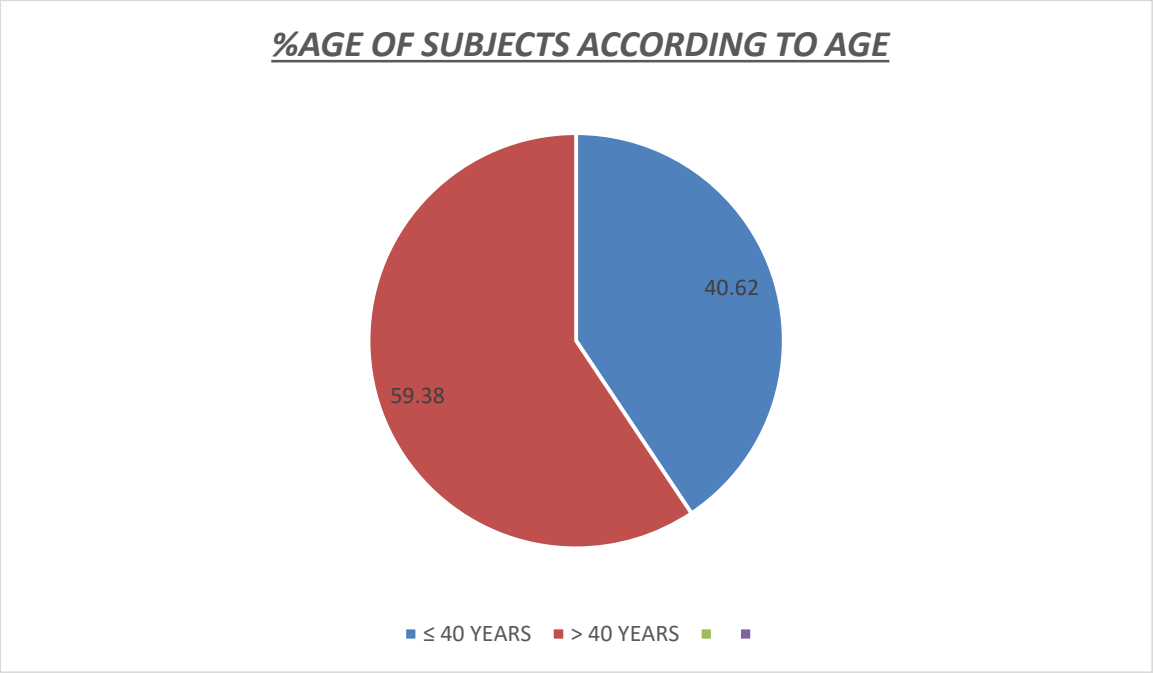


Figure: 1

Overall airway obstruction was seen in 60 (11.71%) subjects. Mild obstruction (GOLD Stage 1) was seen in 42 (70 %) of the cases that have recorded airway obstruction and 8.20% of the total number of subjects. Moderate obstruction (GOLD Stage 2) in 18 (30%) of the subjects that have recorded airway obstruction and 3.51% of the total number of subjects. (Figure 3).

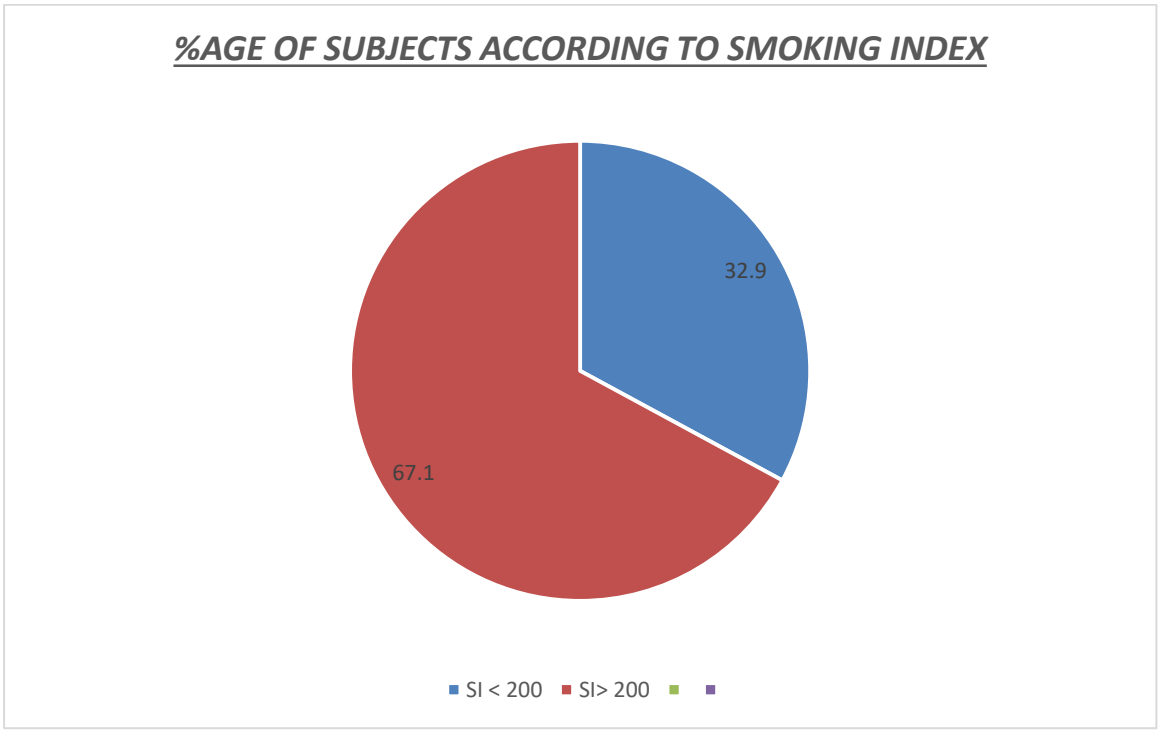
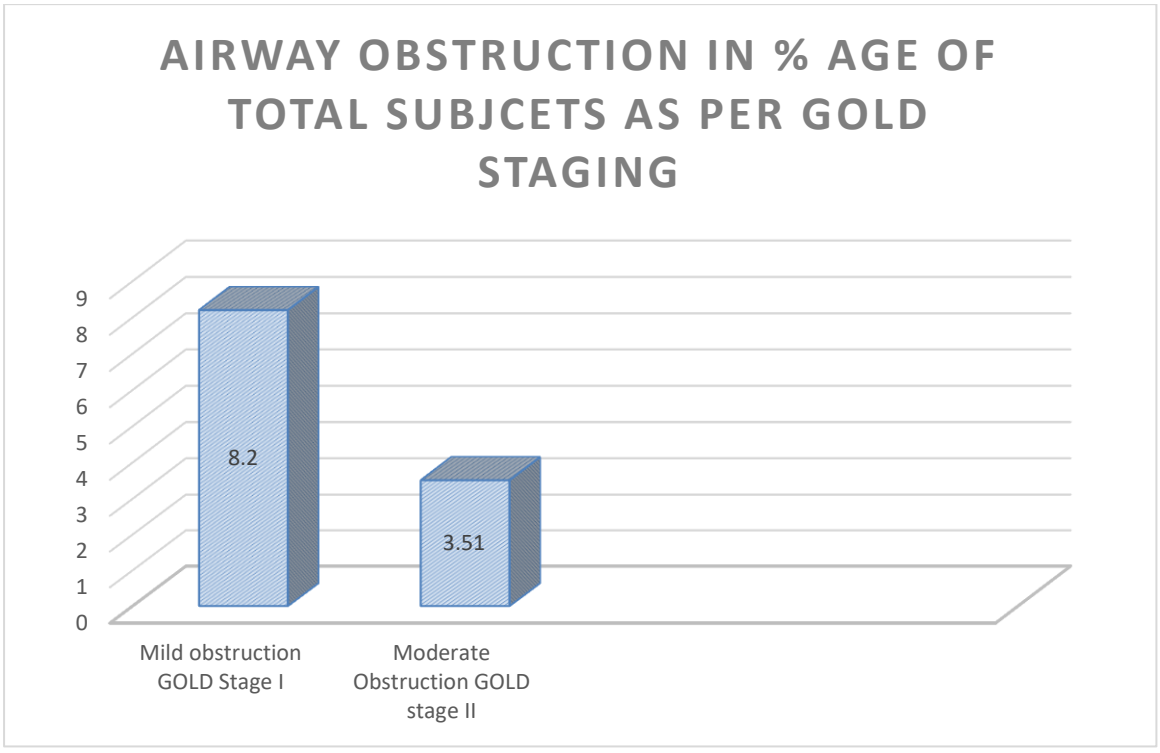


Figure: 2

Airway obstruction was seen in 18 (8.65%) individuals (n=208) who were less than 40 years of age and in 42 (13.81%) who were more than 40 years of age (n=304) (Figure 4). Obstruction was noticed in 52 (14.77%) out of 352 subject with smoking index >200 and 8 (5.00%) out of 160 subjects with smoking index of <200.

In smokers more than 40 years of age and with smoking index more than 200 (n=250), 48 (19.2 %) had obstruction and in smokers less than 40 years of age and smoking index less than 200 (n=160), 05 (3.12%) had obstruction ($p<0.005$) (Figure 5).



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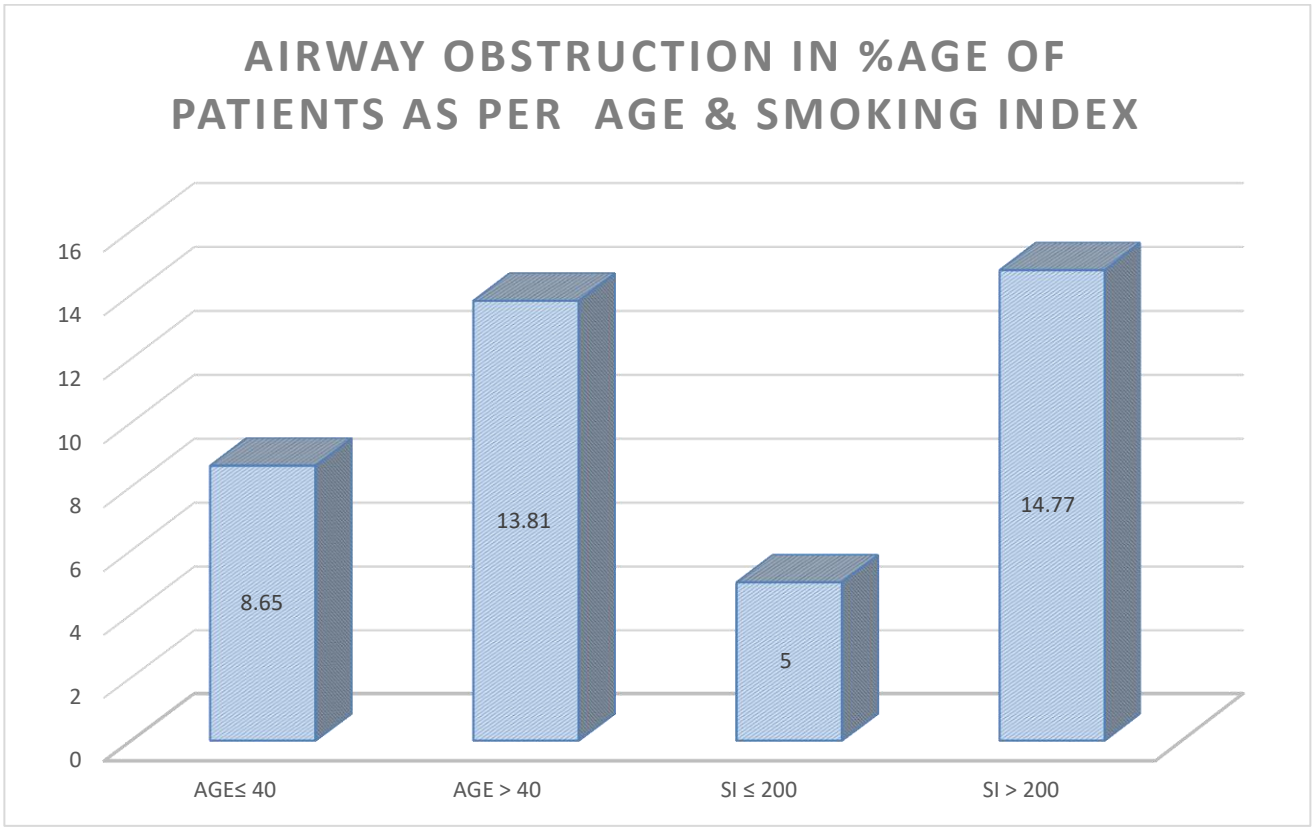

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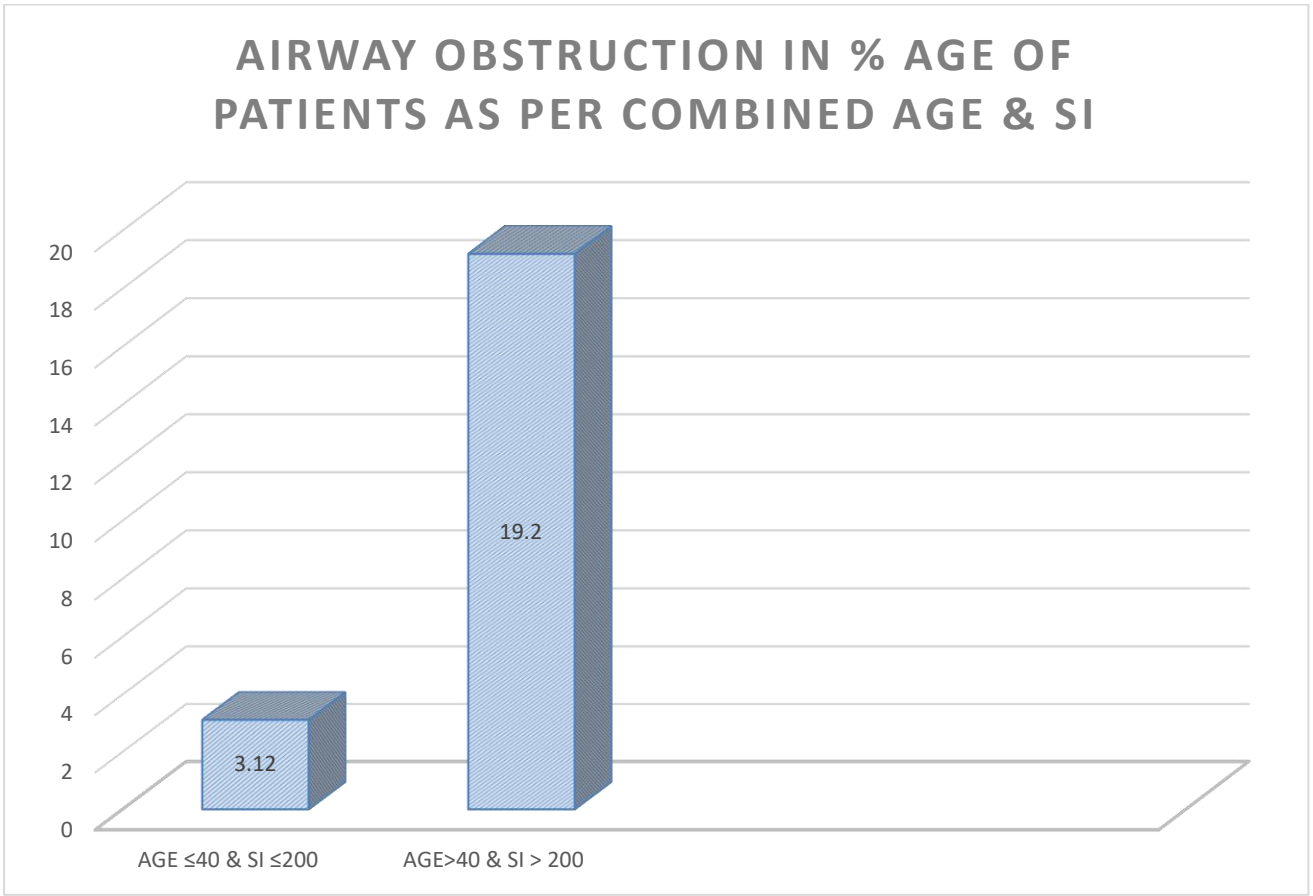

Figure: 5

4. DISCUSSION

Prevalence estimates of COPD differ largely depending on diagnostic instruments used and population studied. Other sources of difference in COPD prevalence estimates are related to different spirometry criteria used for airway obstruction.

Prevalence of COPD varies across countries. Accurate Estimates based on standardized Population based sampling of adults age > 40 years in 12 sites in the BOLD survey indicates an overall COPD prevalence of (GOLD stage II or higher, FEV1 < 80% of predicted) is 10.1 %, SE (4.8).[2,7]

Early diagnosis of COPD with spirometry should provide support for smoking cessation initiatives and lead to reduction of the societal burden of disease, but there are no confirmative data available for the same. However, in Finland, a national prevention and treatment programme for chronic bronchitis and COPD was launched in 1998 in which early diagnosis of COPD was made possible with spirometry followed by management in smoking cessation clinics.[2,6]

By 2003, decline in smoking prevalence and admissions for COPD were recorded providing evidence of the effect of early diagnosis on natural history and burden of COPD. [7,8]

High risk population screening for COPD have been investigated and implemented in Poland. Of 11027 smokers older than 40 years screened, airflow obstruction was found in 24.3%.[7,8,10]

Most of Indian studies have screened population for COPD above 30 years of age. The overall prevalence of COPD in adults is estimated at 4-10%. However, a prevalence of 30-50% has been reported in high risk population such as long-term smokers, depending on the characteristics of the population under study and on the spirometry criteria used for diagnosis. Previous studies have used two methods for early detection of COPD: high risk population screening and case finding. Both methods have their advantages and disadvantages making them complimentary.[15,16,22]

In a study by M S Barthwal et al, involving 460 subjects from military tertiary institute in Pune Maharashtra, of 30 years above were studied for airway obstruction and over all airway obstruction was seen in 12.60%. Airway obstruction was seen in 8.82% subjects who were < 40 years of age and 18% who were more than 40 years of age.[15,16,18]

In our study, airflow obstruction was seen in 11.71% of total subjects with 13.81% in above 40 years of age and 8.65% in below 40 years of age. Most of the population based studies have taken subjects above 30-40 years of age for screening early COPD. In DIDASCO Study (Differential Diagnosis between Asthma and COPD), a population based study, individuals aged 35 to 70 years were subjected to spirometry for early detection of airflow limitation. [21,22,23]

In Lung health study (LHS),10 a multi-centric study conducted in Canada and USA, spirometry screening of more than 73,000 smokers aged 35 to 60 years was performed in 10 centers. Airway obstruction was seen in 21.8% to 35.7% (mean 25%) cases and severe obstruction (FEV1 <50% od predicted) was seen in 5% of the total cases. The lower prevalence of airflow obstruction in our study as compared to LHS study is because of younger age group in our study and asymptomatic smokers. [24,25,26]

A review in 2007 of randomized controlled studies on the value of spirometry as a motivational tool to increase smoking cessation was inconclusive. On telling the smokers their lung age based on spirometry testing increased 12 months sustained cessation of smoking by over 7% irrespective of actual deficit in lung age. [15,16,19,20]

In Another study by Richard et al involved 1737 smokers with no known history of COPD, of these 7.5% smokers were in the likely COPD group, and in 33.2% had FEV1/FEV6 <0.80 or 80 %. [12]

Stralelis G, et al in a study to evaluate a method to detect COPD at an early stage conducted spirometry in 512 smokers, aged 40-55 years with pack-years more than 30 years (equivalent to smoking index of 600) and found obstruction in 27% cases.[17] Similarly, in our study, spirometry conducted on 512 smokers, aged 35-50 years, smokers above 40 years and with smoking index above 200 showed obstruction in 19.2% on spirometry.

5. CONCLUSION

Smoking is by far the most important risk factor for COPD in subjects especially Men. The standard test for screening & early case detection of COPD is Spirometry, with the criterion for diagnosis defined in guidelines being based on FER and severity based on FEV1.

The present study shows that early potential case detection of COPD increases with increasing age and quantum of smoking making the screening method more cost effective in symptomatic than in asymptomatic smokers. Since early

diagnosis provides an excellent opportunity to implement various smoking cessation measures and the earlier the smoker quits the larger the benefits for lung function. Diagnosis of COPD will be delayed if the diagnostic screening is not done at appropriate time, and one will lose out on the health benefits of smoking cessation. At present we do not have confirmatory evidence in support of the statement that early diagnosis of COPD may improve the smoking cessation. It is interfered by present study that early diagnosis of COPD by spirometry, especially in smokers more than 40 years of age and with smoking index of more than 200, is likely to detect COPD by spirometry at an early stage and will positively impact the draining of resources used for screening programmes.

Patient with airflow limitation have high risk of lung cancer, coronary artery disease and stroke. Early diagnosis and treatment may be rewarding and will add many more years of life. Smoking cessation, motivation and other timely preventive measures should be possible if early detection of COPD by spirometry done in primary Health centers and by screening programmes. One way to reduce the cost of such screening programmes is to link spirometry with other screening programmes like detection of diabetes, hypertension and other life style diseases in men.

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